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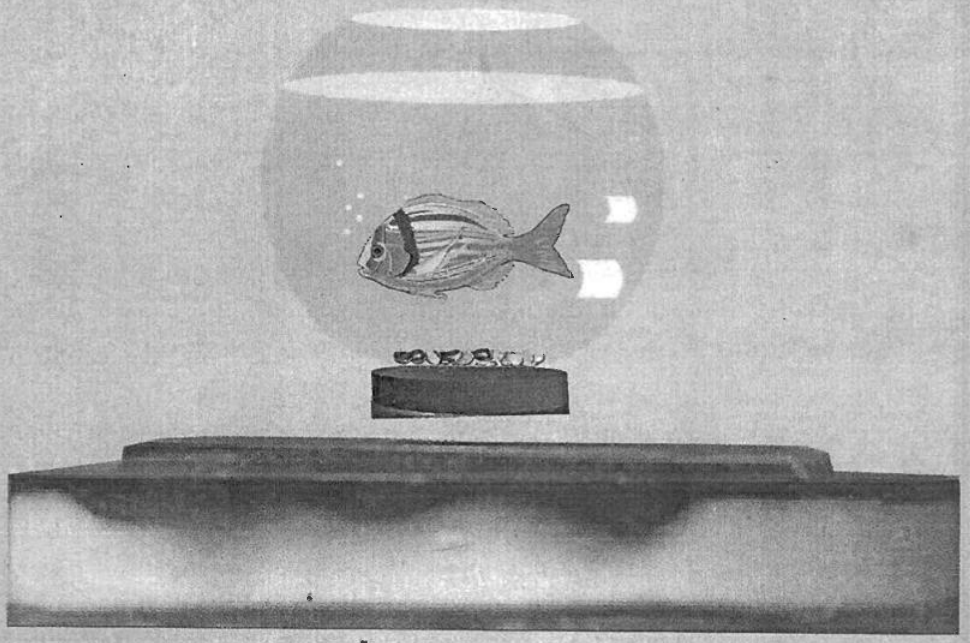
Abstract & Program Book



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CONTENTS

MAGNETISM AND MAGNETIC MATERIALS

M-I-001 Magnetic shape-memory and magnetocaloric effects close to first order transitions 2
M. ACET

M-I-002 Microwave and magnetic properties of nickel and cobalt containing nanomaterials fabricated on organic fiber base 3
V. BOGUSH

M-I-003 Proximity effect in superconductor-ferromagnetic nanostructures 4
A. BUZDIN

M-I-004 A new metallic phase in the Holstein-Hubbard Model in one dimension 5
A. CHATTERJEE

M-I-005 Superconductivity and magnetism in $RuR_{2-x}Ce_xSr_2Cu_2O_{10-\delta}$ (Ru-1222) 6
I. FELNER

M-I-006 Recent experimental results on the superconductor/ferromagnet proximity effect 7
I.A. GARIFULLIN

M-I-007 Magnetic flux penetration into a composite wire from superconducting and ferromagnetic material 8
F. GÖMÖRY, E. PARDO, M. VOJENČIAK, J. ŠOUC, E. SEILER and N. SOLOVYOV

M-I-008 Bilayer manganites: A physics playground 9
K.E. GRAY, QING'AN LI, H. CLAUS, S. ROSENKRANZ, R. OSBORN, H. ZHENG and J.F. MITCHELL

M-I-009 Nanowire-based multiferroic oxide heterostructures 10
A. GUPTA

M-I-010 Physics of oxides with different functionalities 11
H.-U. HABERMEIER

M-I-011 Magnetophotonics of various nanostructures 12
A. BARYSHEV, T. GOTO, R. FUJIKAWA, A. MERZLIKIN, A. VINOGRADOV and M. INOUE

M-I-012 Ab initio studies of rare-earth ad-layers on silicon and germanium surfaces 13
M. PROBERT

M-I-013 FMR studies of half metallic ferromagnets and magnetic oxides 14
B.Z. RAMEEV

M-I-014 Logic based on magnetic tunnel junctions 15
G. REISS, D. MEYNERS, A. THOMAS and M. SCHAEFERS

M-I-015 Effect of Sn addition to the giant magnetocaloric effects of $Gd_5Ge_2Si_2$ 16
R.D. SHULL, V. PROVENZANO, A.J. SHAPIRO, T. ZHANG and Y.G. CHEN

M-I-016 Superconductor-ferromagnet spin-valves: the re-entrant superconductivity in $Nb/Cu_{1-x}Ni_x$ bilayers as a step towards fabrication of the proximity-effect superconducting spin valve 17
A. SIDORENKO, V. ZDRAVKOV, G. OBERMEIER, S. GSELL, M. SCHRECK, C. MÜLLER, S. HORN, R. TIDECKS, V.V. RYAZANOV, M.YU. KUPRIYANOV and L.R. TAGIROV

M-I-017 Towards a microscopic model of magnetoelectric interactions in multiferroic $M_3V_2O_8$ (M=Ni,Co) 18
T. YILDIRIM

M-I-018 Overview on the bonds and bands in boron III-V compounds and their ternary alloys 19
A. ZAOUI

M-I-019 Developing continuous wrapping tantalum barriers for internal-tin Nb_3Sn multi-filamentary wires 20
X.K. (BOB) FU, M. YAVUZ, P. MCINTYRE and W.M. CHEN

M-O-001 Synthesis and characterization of $Zn_{0.6}Ni_{0.4}Fe_2O_4$ magnetic nanoparticles via a PEG-assisted hydrothermal route 22
A. BAYKAL, M. SERTKOL, Y. KOSEOGLU, H. KAVAS and A. C. BASARAN

M-O-002 Magnetoelectric coupling in $BiFeO_3$, $Bi_{0.95}Nd_{0.05}FeO_3$ and $Bi_{0.95}La_{0.05}FeO_3$ multiferroics 23
A.A. AMIROV, A.B. BADTALOV, L.A. REZNICHENKO, O.N. RAZUMOVSKAYA and I.A. VERBENKO

M-O-003 Thermal, magnetic and transport properties of Ni-Mn-Cu-Ga and Ni-Fe-Ga Heusler Alloys 24
A.M. ALIEV, A.B. BATDALOV, L.N. KHANOV, A.G. GAMZATOV, V.D. BUCHELNIKOV, A.S. TASKAEV, I.V. BYCHKOV, G.G. MIKHAILOV, V.V. D'YACHUK, V.V. KHOVAILO, V.V. KOLEDOV and V.G.SHAVROV

M-O-004 Perspective of spintronics applications based on the extraordinary Hall Effect 25
A. GERBER and O. RISS

M-O-005 Thermomagnetic convection as a tool of heat and mass transfer control in magneto-polarized nanosize materials 26
A. BOZHKO and G. PUTIN

M-O-006 Strain and interface effects on the magnetic and transport properties of $La_{0.7}Ca_{0.3}MnO_3$/CaO multilayers 27
A. CASACA, M. A. ROSA, R. P. BORGES, P. FERREIRA, A. SARAIVA, A. P. GONCALVES, R. C. DA SILVA and M. GODINHO

M-O-007 Magnetic torque transferring study for bulk high-T_c superconductors and permanent magnets ... 28
A. WONGSATANAWARID, A. SUZUKI and M. MURAKAMI

M-O-008 The magnetic properties of iron multilayers epitaxially grown on GaAs Single crystal 29
B. AKTAS

M-O-009 Observation of Magnetocaloric Effect in $LaMn_{1.9}Fe_{0.1}Si_2$ compound at low fields in the vicinity of phase transition around room temperature 30
O. NANE, H. AGIL, B. OZKURT, B. OZCELIK and A. GENCER

M-O-010 Deficiency effects on structure and physical properties in the A-site of $Pr_{1-x}Sr_xMnO_3$ manganese oxides with (x=0.2; 0.3; 0.4 and 0.5) 31
W.C. KOUBAA, M. KOUBAA and A. CHEIKHROUHOU

M-O-011 Ferromagnet / Superconductor heterostructures with perpendicular magnetic anisotropy 32
N. JOSHI, C. SURGERS, A. SINGH, W. LOFFLER, H. KALT and H. V. LOHNEYSEN

M-O-012 Magnetic and transport properties of $Pr_{1-x}A_xCoO_3$ perovskites (A = Ca, Sr) 33
I.G. DEAC, R. TETEAN and E. BURZO

M-O-013 α-K_xMnO_2 nanotubes: magnetic and transport properties study 34
D. ARČON, P. UMEK, M. PREGELJ, R. DOMINKO, A. GLOTER, Z. JAGLIČIČ, D. CVETKO and A. LAPPAS

M-O-014 Micromagnetic simulation of multi-bits magnetic recording in patterned ferromagnetic element 35
H. PIAO, D. DJUHANA, S.-K. OH, S.-C. YU and D.-H. KIM

M-O-015 Comparative stray-fields driven modulation of the upper-critical field curve H_{c2}(T) in $Ni_{80}Fe_{20}$-Nb-$Ni_{80}Fe_{20}$ trilayers, Nb-$Ni_{80}Fe_{20}$ bilayers and Nb single layers 36
D. STAMOPOULOS, E. MANIOS, M. PISSAS and D. NIARCHOS

M-O-016 Correlation between polarization and magnetostriction in orthorhombic manganites 37
I. A. RADULOV, V. LOVCHINOV, D. DIMITROV and A. APOSTOLOV

M-O-017 Nanoscale State – Unity of alive and non-alive matter and Biocompatible (non-toxic) ferromagnetic nanoparticles 38
I. DRAGIEVA and B. AKTAS

M-O-018 Superconductivity, antiferromagnetism and ferromagnetism in periodic table of D.I. MENDELEEV 39
L.I. KOROLEVA and T.M. KHAPAEVA

M-O-019 Comparative characteristics of sensors of weak magnetic fields 40
L.P. ICHKITIDZE

M-O-020 Scanning Hall Probe Gradiometry at 77-300K temperature range 41
M. DEDE, R. AKRAM and A.ORAL

M-O-021 Origin of room temperature ferromagnetism in Co-implanted TiO_2 rutile 42
N. AKDOGAN, A. NEFEDOV, R. KHAIBULLIN, L. TAGIROV and H. ZABEL

M-O-022 Anisotropy of Ferromagnetic Heusler Alloy 43
R.YILGIN, B. AKTAS, Y. SAKURABA, M. OOGANE, Y. ANDO and T. MIYAZAKI

M-O-023 Magnetism in single crystals of oxide semiconductors implanted with non-magnetic ions 44
R. P. BORGES, P. VENEZUELA, M. D. MOREIRA, A. T. COSTA, M. M. CRUZ, R. C. DA SILVA, S. MAGALHÃES and M. GODINHO

M-O-024 Precision mapping of the phase diagram of single crystals of multifferoic $RMnO_3$ (R=Ho, Dy) 45
R. PROZOROV, M. D. VANNETTE, A. KREYSSIG, J. YAN, S. NANDI and A. I. GOLDMAN

M-O-025 Local ordering study of nanostructured FeMnAl alloys 46
K. TARIGAN, K.-K. LYU, D-H. KIM, B.-W. KANG, Y.-G. YOO and S.-C. YU

M-O-026 Ferromagnetic resonance study of MgO/Fe/CoO thin films 47
S. KAZAN, N. AKDOGAN, R. YILGIN, M. OZDEMIR, M OBAIDA, H. INAM and K. WESTERHOLT

M-O-027 Quantum size effect on the Zeeman splitting in polar semiconductor quantum dots 48
S. MUKHOPADHYAY and A. CHATTERJEE

M-O-028 Transparent ferromagnetic transition metal doped nanocrystalline SnO_2- a potential multi-functional spintronic material 49
S. C. KASHYAP, K. GOPINADHAN, D.K. PANDYA and S. CHAUDHARY

M-O-029 Micromagnetic study of magnetic domain wall collision in nanowire 50
D. DJUHANA, H. PIAO, S.-H. JUN, J.-H. SHIM, D.-H. KIM, S.-C. YU and S. K. OH

M-O-030 EPR study of Mn-implanted single crystal TiO_2 rutile 51
S. GULER, B. RAMEEV, R.I. KHAIBULLIN, O.N. LOPATIN and B. AKTAS

M-O-031 Phase states and elementary excitations spectra of ultrathin $Fe_{1-x}Co_x$ films 52
Y.A. FRIDMAN, P.N. KLEVETS and A.P. VOYTENKO

M-O-032 Negative refraction in ferromagnetic metallic photonic crystal 54
E. DEMIREL, B. AKTAS, A. C. BASARAN and N. DOGAN

M-O-033 Cation distribution and magnetic properties of Ni-Zn ferrite nanoparticles synthesized by PEG assisted hydrothermal route 55
H. KAVAS, A. BAYKAL, Y. KOSEOGLU, M. SERTKOL, M. TOPRAK and B. AKTAS

M-O-034 Magnetic studies of Barium Calcium hexaferrite powder prepared by sol-gel route 56
R.B.JOTANIA, P. SHARMA and C. C. CHAUHAN

M-O-035 Ferromagnetic nanodots as source of magnetic field: control transport properties of Josephson junctions and superconducting stripes 57
S.N. VDOVICHEV, A.A. FRAERMAN, B.A. GRIBKOV, S.A. GUSEV, A.Y. KLIMOV, Y. N. NOZDRIN, V.V. ROGOV and A.V. SAMOKHVALOV

M-O-036 Arrays of nanoscaled single and multi domain magnetic dots: their effect in magnetic properties of superconducting Nb thin films 58
V. BEKERIS, C. CHILOTTE, D. P. DAROCA, G. PASQUINI, C.-P. LI, F. CASANOVA, J.E. VILLEGAS and I. K. SCHULLER

M-P-001 Effect of anisotropy in one-dimensional Dimer model of magnetic ferrofluids 60
A. OBEIDAT and D. AL-SAFADI

M-P-002 Mixed spin-2 and Spin-5/2 Blume-Capel model 61
A. YIGIT and E. ALBAYRAK

M-P-003 Origin of different magnetic ordering temperatures in $RuSr_2Eu_{1.5}Ce_{0.5}Cu_2O_{10}$ system 62
A. KUMAR, S.K. SINGH, V.P.S. AWANA and H. KISHAN

M-P-004 Magnetic behavior of polymeric composites 63
A.M. ZIHLIF, S. GUSHOU and A.M. ALSMADI

M-P-005 Dielectric and magnetic properties of YIG/PMMA nanocomposites 64
A. QURESHI, A. MERGEN and B. AKTAS

M-P-006 Study on dielectric and magnetic properties of $BaFe_{12}O_{19}$/PVDF multiferroic nanocomposites 65
A. QURESHI, A. MERGEN and B. AKTAS

M-P-007 Characterization of Mn, Cu and X (X=Sr, Zr and Ni) substituted barium ferrite powders prepared by sol-gel method 66
A.GURBUZ, N. ONAR, A. CIRELI, E. CELIK and I. OZDEMIR

M-P-008 Observation of Andreev Saint-James reflections in nano-scale planar superconductor to ferromagnet contacts 67
S. HACOHEN-GOURGY, B. ALMOG and G. DEUTSCHER

M-P-009 Effect of magnesium impurity on magnetic properties of iron borate 68
S.R. BOYDEDAEV and B.Y. SOKOLOV

M-P-010 Rashba spin-orbital splitting in Kane type quantum anti-wires 69
A.M. BABAYEV, S. CAKMAKTEPE and D. T. ALTUG

M-P-011 Electronic structure and magnetic properties of the $Th_xY_{1-x}Co_4B$ intermetallic compounds 70
D. BENEA, O. ISNARD and V. POP

M-P-012 Study of defect densities in Mn^{+2} doped CdS nanocrystals 71
B. TRIPATHI, F. SINGH, D.K. AVASTHI, P.K. KULRIYA, S.A. KHAN, D.DAS and Y.K. VIJAY

M-P-013 Correlation between crystallographic texture and the degree of $L1_0$-ordering in post-annealed Ag/CoPt bilayers and comparison with Ag/CoPt nanocomposites 72
E. MANIOS, D. STAMOPOULOS, I. PANAGIOTOPOULOS and D. NIARCHOS

M-P-014 Low temperature magnetic relaxation, intercluster interaction and resistive switching in $Ca_{0.85}La_{0.15}MnO_3$ manganite 73
E. BOSE, C. L. CHAN, H. D. YANG and B. K. CHAUDHURI

M-P-015 Another alternative to solid state reaction route to synthesize nanocrystalline YIG ($Y_3Fe_5O_{12}$) 74
H. SOZERI and N. GHAZANFARI

M-P-016 Radiosensitivities of parabens: An ESR study 75
I. OZKIRIM and M. KORKMAZ

M-P-017 Ferromagnetism in self-assembled Ge quantum dots material followed by Mn-implantation and annealing 76
I. T. YOON, C. J. PARK, S. W. LEE, T. W. KANG, D. W. KOH and D. J. FU

M-P-018 Magnetic properties of $Co_{1-x}Ni_xFe_2O_4$ ($0 \leq x \leq 1$) nanoparticles prepared by Co-precipitation route 77
K.MAAZ, W. KHALID, A. MUMTAZ and S.K. HASANAIN

M-P-019 Galvanomagnetic effects in Bi_2Te_3 78
T.G. KERIMOVA, N.A. ABDULLAYEV and K.M. MUSTAFAYEVA

M-P-020 Effect of milling speed on the magnetic properties of mechanically alloyed Fe-45%Ni powders 79
KH. GHEISARI, S. JAVADPOUR and J. T. OH

M-P-021 Structural, static and dynamic magnetic studies of evaporated Co_xCr_{1-x}/Si (100) and Co_xCr_{1-x}/glass thin films 80
A. KHARMOUCHE

M-P-022 Magnetocaloric effect in $La_{0.65}Ba_{0.3}M_{0.05}MnO_3$ (M=Na, Ag, K) perovskite manganites 81
M. KOUBAA, W.C. KOUBAA and A. CHEIKHROUHOU

M-P-023 Magnetic and magnetocaloric properties of monovalent substituted $La_{0.65}Ca_{0.3}M_{0.05}MnO_3$ (M=Na, Ag, K) perovskite manganites 82
W.C. KOUBAA, M. KOUBAA and A. CHEIKHROUHOU

M-P-024 What is the origin of ferromagnetism in Mn-doped ZnO system? 83
K.B. GARG, F. BONDINO, E. MAGNANO, M. HEINONEN, E. CARLESCHI and F. PARMIGIANI

M-P-025 Optimization of the magnetoresistive properties of the electron-doped samarium manganites 84
A. KURBAKOV, C. MARTIN, A. MAIGNAN, M. HERVIEU, S. HÉBERT, G. ANDRÉ, F. BOURÉE, J. BROTO, H. RAKOTO and B. RAQUET

M-P-026 Magnetic Properties of Some Fe-Ni Based Alloys 85
H. GUNGUNES, E. YASAR, K. GUVEN and E. GULER

M-P-027 Room-temperature ferromagnetism in novel Mn-doped $ZnSiAs_2$ chalcopyrite 86
V.M. NOVOTORTHEV, S.F. MARENKIN, I.V. FEDORCHENKO, L.I. KOROLEVA, D.M. ZASHCHIRINSKII, T.M. KHAPAEVA, R. SZYMCZAK, B. KRZYMANSKA, V. DOBROWOLSKI and L. KILANSKI

M-P-028 Observation of room temperature ferromagnetism in Cr doped ZnTe films grown onto glass substrate using thermal evaporation method 87
D. SOUNDARARAJAN, D. NATARAJ, D. MANGALARAJ, L. DOROSINSKII and J.S. SALAZER

M-P-029 Magnetic clusters development in $In_{1-x}Mn_xSb$ alloys 89
L. REDNIC, M. COLDEA, V. REDNIC, I. DEAC, M. NEUMANN and I. BALASZ

M-P-030 Optically induced Hall effect in semiconductors 90
M. I. MIAH and E. M. GRAY

M-P-031 Magnetic and electrical properties of cobalt ferrites improved by doping with Zr-Mn for application in magnetic recording media and high frequency devices 91
M.J. IQBAL and M.R. SIDDIQUAH

M-P-032 Magnetization properties of nano-sized $Co_{0.5}Zn_{0.5}Fe_2O_4$ particle by coprecipitation method 92
M. MOZAFFARI, S. MANOUCHEHRI, M. H. YOUSEFI and J. AMIGHIAN

M-P-033 Magnetic properties of mechanochemically prepared Bi-substituted yttrium iron garnet nanopowders 93
J. AMIGHIAN, A. HASANPOUR and M. MOZAFFARI

M-P-034 The effect of salt particles on sintering of annealed FePt nanoparticles 94
M. FARAHMANDJOU, S. A. SEBT, S. S. PARHIZGAR, P. ABEROMAND and M. AKHAVAN

M-P-035 Experimental and numerical study of ferromagnetic cover on critical current of BiSCCO-2223/Ag tape superconductor 95
M. VOJENČIAK, J. ŠOUC and F. GOMORY

M-P-036 Effect of annealing temperature and substitution of Zr-Cu on the magnetic properties of strontium hexaferrite nanoparticles 96
M. N. ASHIQ, M. J. IQBAL and P. H. GOMEZ

M-P-037 Study on the magnetic properties of $Yb_{1-x}Co_xO_3$ thin film system 97
M. ACIKGOZ, L.ARDA and A.C. BASARAN

M-P-038 Switching effects in electrically dipolar manganites 98
V. MORCHSHAKOV, M.P. ANNAORAZOV, H.S. AYBAR, C.P. YANG, I.O. TROYANCHUK and K. BÄRNER

M-P-039 Production, characterization and magneto-optical properties of bismuth-substituted yttrium iron garnet layers prepared by sol–gel process 99
M. EROL, Y. OZTURK, I. AVGIN and E. CELIK

M-P-040 Magnetic properties of the $Pr_{1-x}Gd_xCo_4B$ compounds 100
N. KERVAN, S. KERVAN and A. GENCER

M-P-041 Remnant ferromagnetism in antiferromagnetic $Pr_{0.6}Ca_{0.4}MnO_3$ 101
N. BIŠKUP, A. DE ANDRÉS and M. G. HENANDEZ

M-P-042 Two frequency NQR studies on ^{14}N nuclei 102
N. DOGAN, G.V. MOZZHUKHIN, B.Z. RAMEEV, R.R. HUSNUTDINOV, D.Y. OSOKIN, R. TOPKAYA, H. SUBASI and B. AKTAS

M-P-043 A real probability of antiferromagnetic exchange interactions in dinuclear Cr(III) dithiocorbomates and a ladder like behaviour in magnetic moment 103
O. AYTEKIN and A. BAYRI

M-P-044 Study of ferromagnetism in Mn doped ZnO dilute semiconductor system 104
R.K. SINGHAL, S.N.DOLIA, M.DHAWAN, S.GAUR, S.KUMAR, Y. XING, E. SAITOVITCH and K.B. GARG

M-P-045 Magnetic properties in antiferromagnetic thin films 105
R. MASROUR, M. HAMEDOUN, A. HOURMATALLAH, K. BOUSLYKHANE, N. BENZAKOUR, A. BENYOUSSEF and M. BOUSMINA

M-P-046 Kinetics of initial stage of magnetite nanoparticles formation by chemical precipitation method 106
R.A. ALI-ZADE

M-P-047 Exchange bias in Sr_2YRuO_6 107
RAVI P. SINGH, C.V. TOMY and A.K. GROVER

M-P-048 The structural changing from metallic glass to nanostructure and improvement of the magnetic properties with pulse annealing method (PAM) 108
R. SAHINGOZ, M. EROL and S. YILMAZ

M-P-049 Heusler alloy $Co_2Mn(Ge,Sn)$ thin films studied by FMR technique 109
R.YILGIN, S. KAZAN, B. RAMEEV, B. AKTAS and K. WESTERHOLT

M-P-050 Critical behaviors of the dynamic susceptibility in a spin-1 Ising model 110
R. ERDEM

M-P-051 Low temperature scanning hall probe microscopy with PHEMT, GaN/AlGaN and Si micro hall probes using quartz crystal tuning fork AFM feed back 111
R. AKRAM, M. DEDE and A. ORAL

M-P-052 The mixed state and critical current of thin-film superconductor - ferromagnet bilayer 112
G.M. MAKSIMOVA, R.M. AINBINDER and D.Y. VODOLAZOV

M-P-053 Development of NMR analyzer device 113
R. TOPKAYA, N. DOGAN, H. SUBASI, Y.YERLI and B.RAMEEV

M-P-054 Micromagnetic study of transitional behavior of spin ground states for diamond shaped ferromagnets with aspect ratio variation 114
D. DJUHANA, H. PIAO, S.-H. JUN, S. H. LEE, D.-H. KIM, S. K. OH and S.-C. YU

M-P-055 Growth and FMR characterization of ordered Ni nanowire 115
S. GUNER, S. KAZAN, A.C. BASARAN, T.L. MAKAROVA and E.A. DALCHIELE

M-P-056 Transition metal doped nanocrystalline ZnO – A novel room temperature ferromagnetic semiconductor 116
S. CHAUDHARY, K. P. BHATTI, S. C. KASHYAP and D. K. PANDYA

M-P-057 Čerenkov radiation emerged as a result of collision of elastic e-p on magnetic field in the MIT bates laboratory 117
S. CITCI and B. T. TONGUC

M-P-058 The Antiferromagnetic Ising Model for a Bilayer Bethe lattice .....
E. ALBAYRAK, A. YIĞIT and S. AKKAYA 118

M-P-059 Structural and magnetic properties of NiAlC nano-powders 119
K. TARIGAN, C.-M. HEO, Y. D. ZHANG, Y.-G.YOO, S. K. OH and S.-C. YU

M-P-060 Magnetic resonance study of exchange interaction in europium hexaboride 120
T.S. ALTSHULER, YU. V. GORYUNOV, N.YU. SHITSEVALOVA and A.V. DUKHNENKO

M-P-061 Effect of substitution of Mn by Al in MnNi on the crystallographic structure and magnetic properties 121
V. REDNIC, M. COLDEA, V. POP, M. NEUMANN, L. REDNIC and A. R. TUNYAGI

M-P-062 The structure and magnetic properties of $Fe_{1.2}In_{1.87}Se_4$ single crystals 122
G.G. GUSEINOV, Y.I. ALIYEV, G.M. AGAMIRZOEVA and C. H. BERBARANI

M-P-063 The optimisation of the characteristic parameters of projectile speed in four stage induction coil gun 123
O. KALENDER, I. COSKUN, Y. EGE and S. NAZLIBILEK

M-P-064 Determination of appropriate phase formation with different stoichiometry conditions for Ce substituted YIG thin films produced via sol-gel process 124
Y.OZTURK, M. EROL, I. AVGIN and E. CELIK

M-P-065 Synthesis and characterization of $Co_xZn_{1-x}Fe_2O_4$ magnetic nanoparticles via a PEG-assisted route 125
F. GOZUAK, Y. KOSEOGLU, A.BAYKAL and A.C. BASARAN

M-P-066 First-principle calculation of GaAs electronic structure by doping with Mn and P 126
L.Z. BAO, Y. K. LUN, W. XIA and Z. YA

M-P-067 Theory of negative refractivity in ferromagnetic structures 127
E. DEMIREL and B. AKTAS

M-P-068 Size dependence of noninteracting nanoparticles with crystal field effects 128
O. YALCIN and R. ERDEM

M-P-069 Fabrication and ferromagnetic resonance study of Co nanowires with varying diameter 129
O. YALCIN, G. KARTOPU and A.C. BASARAN

M-P-070 Study of ferromagnetic resonance and Y-K angles in Tb-substituted magnesium ferrites 130
M. AZHAR KHAN, M. U. ISLAM and M. ISHAQUE

M-P-071 Synthesis and characterization of magnetic hydrogels 131
A. GELIR, E. ALVEROGLU, Y. YILMAZ, M. TULUN and H. SOZERI

M-P-072 Mössbauer studies of iron-wüstite nanocomposites 132
M. GHEISARI, M. MOZAFFARI, M. NIYAIFAR and J. AMIGHIAN

M-P-073 Effects of the substitution of gadolinium for neodymium on the crystal and magnetic properties of the $Nd_{1-x}Gd_xCo_4B$ compounds 133
S. KERVAN, N. KERVAN and A. GENCER

M-P-074 Effect of series resistance from metal semiconductor structures 134
S. KARATAS, G. GULER and O. F. BAKKALOGLU

M-P-075 Magnetic properties of the $PrCo_{4-x}Ni_4B$ borides 135
H. AGIL, N. KERVAN, S. KERVAN, H. SOZERI and A. GENCER

SUPERCONDUCTIVITY

S-I-001 Improvement of critical current in $YBa_2Cu_3O_{7-\delta}$ films by silver nano-dots substrate decoration 137
V. S. DANG, A. SARKAR, P. MIKHEENKO, J. S. ABELL and A. CRISAN

S-I-002 Electromagnetic field and AC loss analyses of coils wound with high T_c superconducting tapes 138
N. AMEMIYA and A. HANASATO

S-I-003 Superconductivity of various borides and role of carbon in their high performance 139
V.P.S. AWANA and H. KISHAN

S-I-004 Phase diagrams of the d=3 tJ electronic model with frozen nonmagnetic impurities with application to high-temperature superconductivity: Renormalization-group theory 140
A.N. BERKER

S-I-005 Design of single flux quantum based read-out circuit utilizing time to digital conversion for TES arrays 141
A. BOZBEY, S. MIYAJIMA, H. AKAIKE and A. FUJIMAKI

S-I-006 Vortices in high temperature superconductors: Ideal lattice, pinning, and geometry effects 142
E.H. BRANDT

S-I-007 Recent topics in studies of RNi_2B_2C magnetic superconductors 143
S.L. BUD'KO

S-I-008 A direct solution of the critical state applied to ac losses and magnetisation decay 144
A.M. CAMPBELL

S-I-009 Electromechanical properties of MgB_2 superconductor wires 145
N. CHEGGOUR, L. F. GOODRICH and J. W. EKIN

S-I-010 The potential of magnesium diboride in strand form realized by addressing both intrinsic and extrinsic properties 146
E.W. COLLINGS, M.D. SUMPTION, M. BHATIA and M.A. SUSNER

S-I-011 Artificial pinning centers in $YBa_2Cu_3O_{7-\delta}$ thin films by $Gd_2Ba_4CuWO_y$ nano-inclusions 147
M. M. A. KECHIK, P. MIKHEENKO, A. SARKAR, V. S. DANG, N. HARI BABU, D. A. CARDWELL, J. S. ABELL and A. CRISAN

S-I-012 Investigation of vortex structures in a current carrying Nb wire 148
R. CUBITT, A.S. CAMPBELL, E.M. FORGAN, P.G. KEALEY, S. L. LEE and C.D. DEWHURST

S-I-013 AC losses in a commercial Bi:2223/Ag tape 149
S. CELEBI and I. DUZGUN

S-I-014 High-T_c superconductivity 150
J.D. DOW, D.R. HARSHMAN and A.R. FIORY

S-I-015 Connectivity and critical currents in polycrystalline MgB_2 151
M. EISTERER, J. EMHOFER and H. W. WEBER

S-I-016 Critical fields and pinning mechanisms in disordered MgB_2 152
C.FERDEGHINI, C. BERNINI, V. BRACCINI, A. MALAGOLI, P.MANFRINETTI, A. MARTINELLI, A. PALENZONA, I.PALLECCHI, M. PUTTI, G. ROMANO, C.TARANTINI, M. TROPEANO and M. VIGNOLO

S-I-017 Characterization of bulk and filamentary MgB_2 153
R. FLUKIGER and C. SENATORE

S-I-018 Influence of magnetic materials on transport properties of applied superconductors 154
B.A.GLOWACKI and M. MAJOROS

S-I-019 Status and prospects of ROEBEL assembled cables from coated conductors 155
W.GOLDACKER, A.FRANK, A.KUDYMOW, K.WEISS, S.I.SCHLACHTER, A.KLING and C.SCHMIDT

S-I-020 Under what conditions does MgB_2 sinter? 156
C.E.J. DANCER, R.I. TODD, P. MIKHEENKO, A. BEVAN, J.S. ABELL and C.R.M. GROVENOR

S-I-021 Hole doping in high temperature superconductors 157
N.M. HAMDAN

S-I-022 An overview of superconductivity science and technology 158
D.P. HAMPSHIRE

S-I-023 Superconductivity in boron-doped carbon-nanotubes 159
J. HARUYAMA, S. MARUYAMA, H. SHINOHARA, A.M. RAO and S. SAITO

S-I-024 First-principles study of superconductivity in silver diboride 160
A.K.M.A. ISLAM and F. PARVIN

S-I-025 Generation of high power THz electromagnetic waves form high-T_c superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$ intrinsic Josephson Junctions 161
K. KADOWAKI, H. YAMAGUCHI, K. YAMAKI, M. TSUJIMOTO, T. YAMAMOTO, H. MINAMI, T. HATTORI, M. TACHIKI, H. MATSUMOTO, T. KOYAMA, M. MACHIDA, S. LIN, X. HU, L. OZYUZER, A. E. KOSHELEV, C. KURTER, K. E. GRAY, W. -K. KWOK and U. WELP

S-I-026 Hole and electron doping in MgB_2 single crystals: Influence of substitutions and vacancies on superconducting properties 162
J. KARPINSKI, N. ZHIGADLO, S. KATRYCH, B. BATLOGG, K. ROGACKI and R. PUZNIAK

S-I-027 Coherent dynamic states in mesocrystals of layered superconductors synchronized by internal resonances 163
A. E. KOSHELEV and L. BULAEVSKII

S-I-028 NMR study of a new superconducting phase in a strongly-correlated electron system of $CeCoIn_5$ 164
K. KUMAGAI, T. OYAIZU, N. KONDOH, Y. FURUKAWA, H. SHISHIDO and Y. MATSUDA

S-I-029 Persistent photoconductivity in $YBa_2Cu_3O_x$ 165
W. MARKOWITSCH, W. LANG and J. P. PEDARNIG

S-I-030 Recent progresses in the calculation of superconducting properties of materials from first principles 166
S. MASSIDDA

S-I-031 Fluxonic cellular automata 167
M. V. MILOŠEVIĆ

S-I-032 Shape and pinning induced vortex states in mesoscopic superconductors 168
V.R. MISKO, H. ZHAO, B. XU, B.J. BAELUS,F.M. PEETERS, I.V. GRIGORIEVA, W. ESCOFFIER, L.Y. VINNIKOV and S.V. DUBONOS

S-I-033 Tunneling characteristics of large area superconducting Bi2212 mesas for THz emission 169
L. OZYUZER, Y. SIMSEK, H. KOSEOGLU, F. TURKOGLU, C. KURTER, U. WELP, A.E. KOSHELEV, Q. LI, K. E. GRAY, W. K. KWOK, D. G. HINKS, T. YAMAMOTO and K. KADOWAKI

S-I-034 Flux pinning mechanisms of chemical solution nanostructured YBCO films 170
A. PALAU, J.GUTIERREZ, T. PUIG, A.POMAR and X. OBRADORS

S-I-035 Coexistence of long-range magnetic order and superconductivity studied by dynamic magnetic susceptibility 171
R. PROZOROV, M. D. VANNETTE, R. GORDON, C. MARTIN, S. L. BUD'KO and P. C. CANFIELD

S-I-036 Performance of MgB_2 superconducting magnets 172
K. SALAMA, G. MAJKIC and M. ALESSANDRINI

S-I-037 Electric field effect and superconducting insulating transition in cuprate superconductors 173
M. SALLUZZO

S-I-038 Recent progress of high-temperature superconducting wires and actual application prototypes 174
KEN-ICHI SATO

S-I-039 Nanoscale Andreev-type states induced by quantum confinement 175
A. A. SHANENKO, M. D. CROITORU and F. M. PEETERS

S-I-040 Superconductors with periodic magnetic pinning landscape 176
A.V. SILHANEK, V. METLUSHKO, N. VERELLEN, M.A. MENGHINI, R. KRAMER, W. GILLIJNS, B. ILIC, K. DE KEYSER and V. V. MOSHCHALKOV

S-I-041 Influence of the Pb and Ag doping in the J_c (H,T) dependence and the mechanical properties of Bi-2212 textured rods 177
A. SOTELO, M. A. MADRE, J. C. DIEZ, SH. RASEKH, L. A. ANGUREL and E. MARTINEZ

S-I-042 Studies on development of MgB_2 based superconductors 178
U. SYAMAPRASAD, K. VINOD, N. VARGHESE and P. GURUSWAMY

S-I-043 Terahertz wave emission from cuprate high temperature superconductors 179
M. TACHIKI

S-I-044 Progress of MgB_2 superconductor wire and coils for practical applications 180
M. TOMSIC, M. RINDFLEISCH, D. DOLL, J. YUE, J. PHILLIPS, D. LYONS, M. SUMPTION, E.W. COLLINGS, M. SUSNER, S. BOHNENSTIEHL and S. DOU

S-I-045 Unconventional superconductivity in electron and hole doped iron-based superconductors 181
H.-H. WEN

S-I-046 Pressure and doping effects on critical temperature in two-band Eliashberg theory: Application to MgB_2 and nonmagnetic borocarbides 182
I.N. ASKERZADE

S-I-047 Overview of superconducting and normal state properties of carbon doped and neutron irradiated MgB_2 183
S.L. BUD'KO

S-I-048 Application of superconducting quantum circuits in quantum information systems 184
F. DEPPE, M. MARIANTONI, E. MENZEL, T. NIEMCZYK, A. MARX, E. SOLANO, S. SAITO, T. MENO, K. SEMBA, H. TAKAYANAGI and R. GROSS

S-I-049 Magnetoelectric multiferroic oxide heterostructures: from basic physics to new functionalities .. 185
A. BRANDLMAIER, S. GEPRÄGS, M. WEILER, M. ALTHAMMER, A. BOGER, D. VENKATESHVARAN, M. OPEL, S.T.B. GONNENWEIN and R. GROSS

S-I-050 Complete flux jumping in nano-structured MgB_2 superconductors prepared by mechanical alloying 186
E. YANMAZ, M. BASOGLU, E. T. KOPARAN, N. DILLEY and C.R.M. GROVENOR

S-I-051 MgB_2 in applications, magnets and transformers 187
Y.S. HASCICEK, Y. AKIN and M. TOMSIC

S-I-052 Study of single crystal formation, electrical and magnetic properties of $Ru_{1.5}Sr_2Gd_{1-x}Bi_xCu_3O_y$ materials 188
M. E. YAKINCI, I. KAKEYA, K. YAMAKI and K. KADOWAKI

S-O-001 AC susceptibility and hysteresis loops of a current-carrying thin type-II superconducting disk ... 190
A.A. BABAEI-BROJENY and M. SOHRABI

S-O-002 AC field effects on vortex avalanches in $Mg_{1-x}Al_xB_2$ superconductors 191
A. F. SALEM, KH. A. ZIQ and A. BIANCOUNI

S-O-003 Analytical and numeric analysis of a micro-diamagnetic bearings system 192
A. CANSIZ

S-O-004 Effect of nano-scale magnetite Fe_3O_4 addition on the bulk Bi-2223 superconductors 193
A. KILIC, N. GHAZANFARI, E. ARAS, H. OZKAN and A. GENCER

S-O-005 Field and current controlled switching between vortex states in a mesoscopic superconductor ... 194
A. RYDH, T. GOLOD and V. M. KRASNOV

S-O-006 Physical properties of MgB_2: The implication of the two-band structure model 195
A. VAJPAYEE, M. MUDGEL, V. P. S. AWANA, H. KISHAN and G. L. BHALLA

S-O-007 The electrical properties of YbB_2 under high pressure 196
B. KALKAN, S. SUZER and E. OZDAS

S-O-008 Upper critical fields in superconductor-ferromagnet-superconductor trilayers 197
C. ATTANASIO, J. AARTS, C. BELL, C. CIRILLO and S.L. PRISCHEPA

S-O-009 A thermomechanical spinning method to separate out MgB_2 single crystals to study its magnetic properties 198
C. U. JUNG, I. CHOI and B. W. LEE

S-O-010 Non local effect in Zn-doped Tl-1223 superconductor 199
D. M. AL-SHANGITI and D. KH. A. ZIQ

S-O-011 Influence of surface area and pore size distribution on the superconducting properties of SiC doped MgB_2 200
D. I. DOS SANTOS, A. H. YONAMINE and M. J. SAEKI

S-O-012 The effect of BC and Li-vacancy ordering in LiBC phase on the electrical properties 201
E. GUNGOR and E. OZDAS

S-O-013 Magneto-resistance behavior in high pulsed magnetic fields up to 35 T in thick granular films of $YBa_2Cu_3O_x$ and $YBa_2Cu_3O_x$ (5% Ag -doped) 202
E. BROIDE and M. YAKUNIN

S-O-014 Dissipative flux motion in high-T_c polycrystalline (Bi.Pb)-2223 superconductor added by nano-sized ZrO_2 203
M. ZOUAOUI, A. GHATTAS, M. ANNABI, F. BEN AZZOUZ and M. BEN SALEM

S-O-015 Mechanisms of nonlinearity in the response of magnesium diboride microwave coplanar resonators 204
G. GHIGO, D. ANDREONE, R. GERBALDO, L. GOZZELINO, F. LAVIANO, G. LOPARDO, B. MINETTI, E. MONTICONE, C. PORTESI and E. MEZZETTI

S-O-016 Intermediate state of mesoscopic type-I superconductors: Effect of sample geometry 205
G. R. BERDIYOROV, A. D. HERNANDEZ andF. M. PEETERS

S-O-017 Superconducting properties of noncentrosymmetric $Li_2(Pt_{1-x}Pd_x)_3B$ superconductors 206
H. TAKEYA, S. KASAHARA, M. ELMASSALAMI, K. HIRATA and K. TOGANO

S-O-018 Temperature and pressure dependencies of the elastic moduli of MgB_2 207
H. OZKAN

S-O-019 Quenching characteristics of the transformer type and matrix type fault current limiters 208
H.-S. CHOI

S-O-020 Reel-to-reel continuous deposition of $Ce_xZr_{1-x}O_2$ single buffer layer for YBCO coated conductors 209
J. XIONG , B. TAO, W. QIN, J. TANG, X. FENG, X. SONG, F. ZHANG, J. TANG and Y. LI

S-O-021 Interplay between superconductivity and magnetism in high-T_c cuprates 210
L.S. MAZOV

S-O-022 Vortex pinning enhancement in Mn-doped YBCO superconductor 211
B.A. ALBISS, I.M. OBAIDAT, S.A. BARHOUM, M. GHARAIBEH and M.K. HASAN (QASEER)

S-O-023 Effect of α-Al_2O_3 nanopowder additive on phase formation and superconductivity properties of $Bi_{1.6}Pb_{0.4}Sr_{1.9}Ca_{2.1}Cu_3O_{10-\mu}$ 212
A. AFTABI, M. MOZAFARI, P. KAMELI and H. MASOUDI

S-O-024 Optimization of the Pr concentration in $Y_{1-x}Pr_xBCO$ films prepared by pulsed laser deposition ... 213
M. IRJALA, H. HUHTINEN, P. PATURI, H. KISHAN, V. P. S. AWANA, A. V. NARLIKAR and R. LAIHO

S-O-025 Peculiarities of the microwave conductivity of superconducting single crystals with different doping levels 214
M.R. TRUNIN

S-O-026 Effect of oxygenation on magnetic performance of $(Nd,Eu,Gd)Ba_2Cu_3O_y$ bulk with a lamelar nanostructure 215
M. JIRSA, M. RAMES, M. MURALIDHAR and P. DIKO

S-O-027 A DFT study of the UCoGe magnetic superconductor 216
P. DE LA MORA and O. NAVARRO

S-O-028 Pinning behaviour of Cu substitutions in YBCO TSMG bulk superconductors 217
P. DIKO, V. ANTAĽ, M. KAŇUCHOVÁ, V. KAVEČANSKÝ, GRITZNER and J. KOVÁČ

S-O-029 Critical current anisotropy of MgB_2 tapes 218
P. KOVÁČ

S-O-030 Josephson modulation of the critical current in YBCO films near T_c 219
P. BERNSTEIN, Y. BOUGHERIRA, J.F. HAMET, Y. THIMONT and L. MÉCHIN

S-O-031 The effect of nano-particles in MgB_2 films on stainless steel substrate 220
Y.-B. WANG, S.-Y. YI and Q.-R. FENG

S-O-032 Electrodynamic behavior of a two-junction quantum interferometer enclosing a superconducting nanocylinder 221
R. DE LUCA

S-O-033 Symmetric and non-symmetric vortex-antivortex molecules in a fourfold superconducting geometry 222
R. GEURTS, M. V. MILOŠEVIĆ and F. M. PEETERS

S-O-034 Current state of MgB_2 superconducting wire manufacturing and prospects for their applications..... 223
A. TUMINO, S. BRISIGOTTI, D. PIETRANERA, S. BERTA, R. PENCO, E. DEMENCIK, and G. GRASSO

S-O-035 Critical current densities of isolated grain boundaries in coated conductors 224
S.C. SPELLER, M. WEIGAND, J.H. DURRELL and N.A. RUTTER

S-O-036 Effect of pinning size on the Bose-Glass melting 225
U. AL KHAWAJA, M. BENKRAOUDA, I.M. OBAIDAT and B.A. ALBISS

S-O-037 Effect of substitution at different site of heavily Fe-substituted high-T_c superconductors 226
T. WUERNISHA, T. MOCHIKU, Y. HATA, A. HOSHIKAWA, Y. MATSUSHITA, H. FUJII, H. YASUOKA and H. KITAZAWA

S-O-038 Artificial pinning centers using ordered nanoporous alumina templates: Time effect on magnetization curves of nanostructured Nb films 227
X. HALLET, S.M. TEMPFLI, M.M. TEMPFLI, L. PIRAUX, W. VINCKX, J. VANACKEN and V.V. MOSHCHALKOV

S-O-039 Electrothermal performance and growth of single phase in barium doped Bi-2223 high-T_c superconductors 228
M. ANIS-UR-REHMAN

S-O-040 Magnetic and XPS studies of $(Fe_{1-x}V_x)SmAsO$ superconductor 229
KH. A. ZIQ, A.F. SALEM, M. FAIZ and A. GHANNAM

S-O-041 Comparative mechanical properties of YBaCuO, BiSrCaCuO and MgB_2 superconductor materials 230
O. UZUN, U. KOLEMEN, S. CELEBI, E. YANMAZ and M.E. YAKINCI

S-O-042 Positronium in void in high-T_c superconductor 231
V.L. SEDOV

43 Difference between Al and C doping in the upper critical field of MgB_2 single crystals 232
B. KANG, T. H. DUC, K.-K. LYU, M.-S. PARK, H.-J. KIM, H.-S. LEE, S.-I. LEE, Y. JO and M.-H. JUNG

S-O-044 Design of cryogenic systems for HTS-applications 233
H. VERMEULEN (BAS)

S-O-045 Development of MgB_2 superconductors towards industrial applications 234
G. GRASSO

S-P-001 Influence of Pr substitution on acoustic Gruneisen Parameter and lattice vibrational anharmonicity in ceramic superconductors 236
A.K. YAHYA

S-P-002 Read-out of the response of YBCO transition edge bolometers by dc-SQUIDs: Response characteristics and coupling optimization 237
A. BOZBEY, R. AKRAM, I. AVCI and M. FARDMANESH

S-P-003 Response analysis of free membrane transition-edge detectors with thin substrates 238
A. KOKABI, M. HOSEINI, A. H. KHOSHAMAN, S. RAZMKHAH, A. MOFTAKHARZADEH, A. BOZBEY and M. FARDMANESH

S-P-004 Development of cube textured NiCuCo alloy substrates for YBCO coated conductors 239
A. VANNOZZI, A. MANCINI, G. CELENTANO, A.A. ARMENIO, A. AUGIERI, L. CIONTEA, V. GALLUZZI, U. GAMBARDELLA, T. PETRISOR, A. RUFOLONI and G. THALMAIER

S-P-005 Revisiting the $Y_{1-x}Pr_xBa_2Cu_3O_7$ System - CuO_2 plane disorder induced flux pinning 240
A. KUMAR, S. K. SINGH, A. VAJPAYEE, M. MUDGEL, R.S. MEENA, V.P.S. AWANA and H. KISHAN

S-P-006 Dependence of the structural, electrical and magnetic properties of the superconductive YBCO thin films on the deposition rate 241
A.B. KARCI, M.TEPE and H. SOZERI

S-P-007 Theory of Nernst Effect in layered superconductors 242
B.D. TINH and B. ROSENSTEIN

S-P-008 Transport and AC susceptibility measurements on silver wrapped pellets of $Bi_{1.7}Pb_{0.35}Sr_{1.9}Ca_{2.1}Cu_3O_y$ superconductors 243
C. TERZIOGLU, D. YEGEN, A. VARILCI and I. BELENLI

S-P-009 Transport and magnetic properties in layered rare-earth (RE) transition metal (TM) pnictide(PN)-oxide quaternary compounds 244
M.FERRETTI, P.MANFRINETTI, A.MARTINELLI, A.PALENZONA, M.R CIMBERLE, C.FERDEGHINI, M.PUTTI, A.S.SIRI and M.TROPEANO

S-P-010 Magnetic and superconducting properties of $La_{0.7}Sr_{0.3}MnO_3$/YBCO double layer thin film 245
C. BIRLIKSEVEN, U. TOPAL, M.E. YAKINCI and T. NURGALIEV

S-P-011 Vortices fluctuation of Zn- doped Tl-1223 superconductor 246
D.M. AL-SHANGITI and KH. A. ZIQ

S-P-012 The effect of extreme rolling on the properties of commercial MgB_2 tapes 247
E. YUCEL and I. BELENLI

S-P-013 Fluctuation conductivity in nano-sized Al_2O_3 added (Bi,Pb)-2223 superconductors under applied magnetic field 248
F. B. AZZOUZ, A. GHATTAS, M. ZOUAOUI, M. ANNABI and M. B. SALEM

S-P-014 Transport current effect on microwave surface resistance of type-II superconductors 249
F. INANIR, S. YILDIZ, U. KOLEMEN, I. DUZGUN, M. ALTUNBAS and S. CELEBI

S-P-015 A model for granular superconductors 250
F. INANIR, I. DUZGUN, M. ALTUNBAS and S. CELEBI

S-P-016 Large area mesas on Ca-rich Bi2212 for THz generation 251
F. TURKOGLU, Y. SIMSEK, H. KOSEOGLU and L. OZYUZER

S-P-017 Percolation phenomena in compositions semiconductor-superconductor 252
G.I. ISAKOV and S. USHERENKO

S-P-018 Enhancement of the Bean-Livingston barrier for vortex entry on nodal surface of $YBa_2Cu_3O_{7-\delta}$ 253
G. LEIBOVITCH, R. BECK and G.DEUTSCHER

S-P-019 Bolometric response of high-T_c superconducting $YBa_2Cu_3O_{7-\delta}$ transition edge bolometer for near-infrared region 254
D. ABUKAY, H.Y. GUNEL, B. PEKERTEN and S. TOZAN

S-P-020 DC V-I characteristics of a HTS tape for a 600kJ SMES in an oblique external magnetic field... 255
H.J. KIM, Z. LI, Y.H. MA, K.C. SEONG, S.H. KIM and K. RYU

S-P-021 Selective ion etching of Ta/Au/Bi2212 superconducting multilayers for generation of THz waves 256
H. KOSEOGLU, Y. SIMSEK, F. TURKOGLU and L. OZYUZER

S-P-022 Design of a field coil for 5MW HTS synchronous motor 257
H.M. KIM and Y.-K. KWON

S-P-023 Oxygen stoichiometry changed by Ca doping in the $(R_{1-x}Ca_x)Ba_2Cu_3O_y$, where R = Ho, Er, Tm, Yb 258
J. H. YAM, H.-C. I. KAO, J.M. CHEN, H.S. HSEU and D.C. LING

S-P-024 The effect of Gd addition on properties of $Bi_{1.8}Pb_{0.35}Sr_{1.9}Ca_{2.1}Cu_3Gd_xO_y$ superconductors 259
H. AYDIN, M. NURSOY, I. BELENLI and C. TERZIOGLU

S-P-025 Structural analysis of sol-gel prepared $Hg_{1-x}Ho_xBa_2Ca_2Cu_3O_8$ (x=0, 0.05, 0.1, 0.15, 0.2) 260
H. ASLAN, A. COSKUN and C. SARIKURKCU

S-P-026 DC magnetization and flux creep in a multiflamentary Bi:2223/Ag tape: H ⊥ c axis 261
I. DUZGUN, A. OZTURK, F. INANIR and S. CELEBI

S-P-027 Irreversibility line in a Bi:2223/Ag tape determined from two different techniques: H // c axis ... 262
I. DUZGUN, A. OZTURK, F. INANIR, T. KUCUKOMEROGLU and S. CELEBI

S-P-028 YBCO superconducting films by TFA-MOD method 263
I. BIRLIK, O. CULHA, M. TOPARLI and E. CELIK

S-P-029 Effect of Pr-doping on magnetic and transport properties in $YBa_2Cu_3O_{7-\delta}$ single crystal superconductor 264
J. ZHANG, Z.G. QIN, G. JIN, M. CHEN, X. YAO, C. CAI and S. CAO

S-P-030 Transport properties in Cu_xTiSe_2 single crystals 265
A.E. KARKIN, B.N. GOSHCHITSKII and V.V. FEDORENKO

S-P-031 Vortex shaking effects in MgB_2 superconductor 266
KH. A. ZIQ, A.F. SALEM and A. GHANNAM

S-P-032 Mechanism of quenching of superconductivity in the $YBa_2Cu_3O_{7-\delta}$ system on substitution of Zn for Cu 267
K.B. GARG, P. NORDBLAD and S. CARLSON

S-P-033 MgB_2 bulks obtained by RLI technique: annealing and nanoparticle doping effects on material electrical properties 268
L.GOZZELINO, B. MINETTI, G.A. UMMARINO, R. GERBALDO, G. GHIGO, F. LAVIANO, G. LOPARDO, G. GIUNCHI, E. PERINI, E. BASSANI, A. AGOSTINO and E. MEZZETTI

S-P-034 Magnetomodulation superconducting sensor of weak magnetic field 269

L.P. ICHKITIDZE and M.V. BELODEDOV

S-P-035 Nonvacuum textured growth of $(Gd_{1-x}Yb_x)_2O_3$ buffer layers for YBCO coated conductor 270
L. ARDA

S-P-036 Fabrication of thin film YBCO high temperature superconductors by PED 271
M. ERTUGRUL and M.E. SAGSOZ

S-P-037 XPS/XRD/AFM characterization of $Mg_{1-x}Al_xB_2$ superconductor 272
M. FAIZ, A.F. SALEM, N. TABET and Kh. ZIQ

S-P-038 Numerical investigation of vortex melting at high vortex density as function of pinning density and strength 273
M. BENKRAOUDA, I. OBAIDAT and U. AL KHAWAJA

S-P-039 Superconductors in researches and diagnistics of biological objects 274
L.P. ICHKITIDZE

S-P-040 Dynamic fatigue behaviour of textured bi-2212 thin rods 275
M.A. MADRE, J. C. DIEZ, A. SOTELO, H. AMAVEDA and SH. RASEKH

S-P-041 Relationship between residual stress and the critical current density of Cu/MgB_2 wires 276
L. ARDA, S. ATAOGLU and Y.S. HASCICEK

S-P-042 Enhancing the transport properties of polycrystalline MgB_2 superconductors 277
I.M. OBAIDAT, B.A. ALBISS, M. GHARAIBEH and M.K. HASAN (QASEER)

S-P-043 Effect of partial substitution of Ca by 4f elements on dissipative processes in Bi:2223 superconductors 278
D.MARCONI, G. STIUFIUC and A.V.POP

S-P-044 A study of the phase diagram of a $Bi_2Sr_2Ca(Cu_{1-y}Zn_y)_2O_{8-\delta}$ thin film by transport measurements 279
I. MATEI, Z.Z. LI and H. RAFFY

S-P-045 Anomalous ferromagnetic behaviour of Y_2O_3 and CuO nanoparticles in $YBa_2Cu_3O_y$ superconductor 280
M. BASOGLU, K. OZTURK, S. CELIK, C.R.M. GROVENOR and E. YANMAZ

S-P-046 Spin polarized tunneling spectroscopy of intercalated $Bi_2Sr_2CaCu_2O_{8+\delta}$ superconductors 281
M. OZDEMIR and L. OZYUZER

S-P-047 SPM investigation of polycrystalline $Bi_2Sr_2Ca_{1.8}Ba_{0.2}Cu_3O_{10+x}$ system 282
V. MIHALACHE, M. DEDE, A. ORAL and H. SHTRIKMAN

S-P-048 Magnetic resistivity at various angle between an external magnetic field and a surface of superconductivity ceramics 283
L.P. ICHKITIDZE

S-P-049 Magnetic and structural properties of Bi2212 superconducting ceramics co-doped by Pb and La 284
A. AIT KAKI, F. BENMAAMAR, M.-F. MOSBAH and A. AMIRA

S-P-050 An overview of high-T_c cuprate superconductors 285
M.A. MOJUMDER

S-P-051 Effect of PbO addition on microstructure and electrical properties of $YBa_2Cu_3O_y$ superconductor 286
M. ZOUAOUI, D. K. MANI, F. BEN AZZOUZ, M. ANNABI and M. BEN SALEM

S-P-052 Characterization of bulk $Y_{0.6}Gd_{0.4}BaCu_{3-x}Nb_xO_{7-\delta}$ superconductor 287
M. YILMAZ, Z. MUTLU, Y.G.GUCUMAN, I. DUZ and O. DOGAN

S-P-053 The influence of cooling rates on microstructure and mechanical properties of $Bi_{1.6}Pb_{0.4}Sr_2Ca_2Cu_3O_y$ superconductors 288
H.A. CETINKARA, M. YILMAZLAR, M. NURSOY, C. TERZIOGLU and O. OZTURK

S-P-054 High pressure single crystal growth and characterization of $MgCNi_3$ 289
N.D. ZHIGADLO, S. KATRYCH and J. KARPINSKI

S-P-055 $MgCu_2$ formation due to strong interaction of soft copper sheath with (Mg+2B) core fabricated by in-situ PIT method 290
N. HORZUM, T. OZGEN and S. OKUR

S-P-056 General characterization of $Y_{1-x}Co_xBa_2Cu_3O_{7-\delta}$ 291
N. DOGAN, M.E. YAKINCI, Y. BALCI and M.A. AKSAN

S-P-057 Minute hBN addition to bulk Bi-2223 superconductor 292
M. AKDOGAN and I. BELENLI

S-P-058 New molecular conductors with bromine derivative of the cobalt bis(dicarbollide) anion 293
O.N. KAZHEVA, GG.ALEXANDROV and O.A. DYACHENKO

S-P-059 A non perturbative large-N expansion for the Generalized Hubbard Model 294
O.S. ZANDRON

S-P-060 Characterization of bulk $Y_{0.6}Gd_{0.4}Ba_{2-x}Nb_xCuO_{7-\delta}$ superconductor 295
M. YILMAZ, Z. MUTLU, I. DUZ, Y.G.GUCUMAN and O. DOGAN

S-P-061 Influence of annealing temperature on the microstructure and mechanical properties of MgB_2 ... 296
O. GORUR, M. NURSOY, C. TERZIOGLU, A. VARILCI and I. BELENLI

S-P-062 The chaotic points and XRD analysis of the Hg-based superconductor 297
O. ASLAN, Z.G. OZDEMIR and U. ONBASLI

S-P-063 The effect of Mo substitution on micro-structural and transport properties of $Y_{1-x}Mo_xBa_2Cu_3O_{7-\delta}$ system 298
N. DOGAN, M.E. YAKINCI, L. ARDA, Y. BALCI and M.A. AKSAN

S-P-064 Influence of gold diffusion-doped on phase formation, superconducting and microstructure properties of Bi-2223 superconductors 299
O. OZTURK, C. TERZIOGLU and A. GENCER

S-P-065 Anomalous quadrupole feature in the mixed state of YNi_2B_2C superconductor 300
P. DAS, C.V. TOMY, H. TAKEYA, S. RAMAKRISHNAN and A.K. GROVER

S-P-066 Superconducting properties and Hall Effect of epitaxial NbN thin films grown through reactive magnetron sputtering 301
S.P. CHOCKALINGAM, M. CHAND, J. JESUDASAN, V. TRIPATHI and P. RAYCHAUDHURI

S-P-067 Localized magnetic polaritons in antiferromagnetic superlattices with impurity 302
R. ASKERBEYLI (TAGIYEVA) and B.TANATAR

S-P-068 The influence of sintering temperature on electric and mechanical properties of (Bi,Pb):2223 system 303
A.V. POP, C. LUNG, R. COLDEA and M. POP

S-P-069 A key two-component scenario for unconventional superconductivity in high-T_c superconductors 304

S. DZHUMANOV

S-P-070 Investigation of physical and structural properties of cesium doped yttrium-based superconductors 305
S. NEZIR, M. YILMAZLAR and O. BAG

S-P-071 Effects of Zn substitution in $La_{2-x}Sr_xCu_{1-y}Zn_yO_4$: Interplay among superconductivity, pseudogap, and stripe order 306
S. H. NAQIB and R. S. ISLAM

S-P-072 Effect of boron precursor purity on the superconducting properties of in-situ Fe/MgB_2 wires 307
N. HORZUM, T. OZGEN and S. OKUR

S-P-073 Low-field AC susceptibility study of the flux motion in $Bi_2Sr_2CaCu_2Oy$ thin films 308
A.V. POP, S. MANOLACHE, I. MATEI and V.POP

S-P-074 Application effect «Usherenko» for production of new superconductors and magnetic materials 309
S. USHERENKO and G.I. ISAKOV

S-P-075 Effect of excess Mg on in-situ and ex-situ stainless steel clad MgB_2 wires 310
S. OKUR and S. OKUR

S-P-076 Flux behavior in $YBa_2Cu_3O_{7-x}$ fabricated by melt-powder-melt-growth (MPMG) and flame-quench-melt-growth (FQMG) processes 311
S. KUTUK, S. BOLAT and E. YANMAZ

S-P-077 On the mechanism of ac losses in superconducting MgB_2 thin films 312
S. P. CHOCKALINGAM, S. SARANGI and S. V. BHAT

S-P-078 Electron phonon coupling constant of $La_{2-x}Sr_xCuO_4$ (x=0.10-0.20) high-temperature superconductor 313
S. GUPTA and S.C.GOYAL

S-P-079 Calculation of critical current density from magnetic levitation force for $YBa_2Cu_{3-x}RE_xO_y$ (RE=Yb, Sm, Nd) superconductors 314
S. BOLAT and E. YANMAZ

S-P-080 From the Ginzburg-Landau energy to vortex lattice problems 315
E. SANDIER and S. SERFATY

S-P-081 Competing effects of surface phonon softening and quantum size effect on the superconducting properties of nanostructured Pb 316
S. BOSE, C. GELANDE, S.P. CHOCKALINGAM, R. BANERJEE, P. RAYCHAUDHURI and P. AYYUB

S-P-082 Investigation of effect of x in $Yb_{1-x}Gd_xBa_2Cu_3O_{7-y}$ Superconducting structures on upper critical magnetic field and coherence length 317
S. CELIK, K. OZTURK and E. YANMAZ

S-P-083 Ammonium -nitrate -melt -technique for the synthesis of ceramic compounds 318
U. TOPAL

S-P-084 Studies on electrical and magnetic properties of melt textured growth $YBa_2Cu_3O_{7-x}$ superconducting bulk materials 319
U.S. GOKAY and M. TEPE

S-P-085 Stable and metastable vortex lattice configurations throughout the Peak effect 320
V. BEKERIS, D. PÉREZ DAROCA, C. CHILOTTE and G. PASQUINI

S-P-086 Non-magnetic electronic correlations in high-T_c cuprates 321
W. WINKLER

S-P-087 Terahertz oscillations in mercury cuprate superconductors 322
Z.G. OZDEMIR, O. ASLAN and U. ONBASLI

S-P-088 Improved of superconducting properties in MgB_2 by shifting of Ar ambient pressure and sintering conditions 323
B. SAVASKAN, K. OZTURK, S. CELIK, M. BASOGLU and E. YANMAZ

S-P-089 Low-field electrodynamics of high temperature TBCCO polycrystalline superconductor 324
I. METSKHVARISHVILI, M. METSKHVARISHVILI and I. NADOEVA

S-P-090 The topological resonance state in high-T_c cuprates –An unusual quantum state 325
W. WINKLER

S-P-091 Investigation of Josephson junction critical current density of polycrystalline HTSC in linearly polarized and circularly polarized ac fields 326
I. METSKHVARISHVILI, M. METSKHVARISHVILI and I. NADOEVA

S-P-092 The origin of the in-gap states and bands in the underdoped cuprates 327
S.DZHUMANOV, U.T. KURBANOV, Z.S. KHUDAYBERDIEV and O.K. GANIEV

S-P-093 Magnetoresistance properties of MgB_2 thick films on YSZ substrate using spray pyrolysis method 328
M. OZABACI, Z. D. YAKINCI, S. ALTIN, M. A. AKSAN, Y. BALCI and M. E. YAKINCI

S-P-094 On the two band model in pure and doped BSCCO superconductors 329
A. SEDKY, S. DESOKY and A. AL- SAWALHA

S-P-095 The metal-insulator transition in high-T_c cuprates –An unusual quantum transition 330
W. WINKLER

S-P-096 The effect of sintering temperature on structural parameters in Sb substituted Bi-2223 superconducting samples 331
N. YASAR, O. BILGILI and K. KOCABAS

S-P-097 Thermal properties in the Ce substituted BSCCO-2223 HT_c system prepared by glass-ceramic technique 332
M. A. AKSAN, R. OZTURK, S. ALTIN, Y. BALCI and M. E. YAKINCI

S-P-098 The effect of lutetium doping on magnetic behaviour of YBCO superconductors 333
A.OZTURK, I.DUZGUN and S.CELEBI

S-P-099 1D superconducting-dielectric photonic crystals 334
A.H. ALY and C.K. HWANGBO

S-P-100 Pinning properties of Bi-2212 single crystal whiskers 335
S. ALTIN, M. A. AKSAN, Y. BALCI and M. E. YAKINCI

S-P-101 Effects of ZnO addition on mechanical properties of $Bi_{1.84}Pb_{0.34}Sr_{1.91}Ca_{2.03}Cu_{3.06}O_{10}$ prepared by a wet technique 336
I. KARACA, O. UZUN, F. YILMAZ, O. SAHIN and U. KOLEMEN

S-P-102 Superconductor ferromagnet bilayers; experimental investigation of spin polarized transport across the interface 337

S.K. WANCHOO, J. JOHN, S. P. PAI, A. M. NARSALE and R. PINTO

S-P-103 Effects of izostatic and biaxial pressure during the preparation of MgB_2 tapes 338
Z.D. YAKINCI, Y. BALCI, S. ALTIN, M.A. AKSAN and M.E. YAKINCI

S-P-104 Determination of the β-material for bulk BSCCO superconductor 339
O. UZUN and N. GUCLU

S-P-105 Slow rotational force and torsional stiffness analysis in the superconducting magnetic bearings 340
A. CANSIZ

S-P-106 Loss analysis of a 1 MW class HTS synchronous motor 341
S. K. BAIK, Y.K. KWON, H. M. KIM, E.Y. LEE, J. D. LEE, Y. C. KIM, H. J. PARK and W. S. KWON

S-P-107 Superconductivity of $Nb_{1-x}Mg_xB_2$: Impact of stretched *c*-parameter 342
M. MUDGEL, V.P.S. AWANA, H. KISHAN and G.L. BHALLA

S-P-108 The effect of filament coupling on ac losses in multifilamentary MgB_2 wires 343
S. SAFRAN, N. GUCLU, G. GRASSO, I. BELENLI, H. SOZERI, A. KILIC and A. GENCER

S-P-109 Non-fluorine metal organic deposition approach to superconducting YBCO thin film 344
Y. ZHAI, M.H. PU and Y. ZHAO

INDEX 345

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AUGUST 25-29, 2008-SİDE-ANTALYA,TURKEY

M-O-025

Local ordering study of nanostructured FeMnAl alloys

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The structural and magnetic properties of mechanically alloyed $Fe_{55}Mn_{10}Al_{35}$ alloys were studied as a function of milling time. The local structural change of FeMnAl has been investigated by means of X-ray diffraction (XRD), extended x-ray absorption fine structure (EXAFS) and Mössbauer spectrometry. The magnetic properties were measured using vibrating sample magnetometer (VSM) at room temperature. With increase of milling time, the XRD patterns were broadened and the intensity was reduced. The XRD pattern from 24 hours alloyed FeMnAl powders exhibited bcc structural phase. The local structure and atomic ordering were examined by EXAFS experiment. The EXAFS spectra were obtained Fe K-edge. The radial atomic density in a real space can be shown in the Fourier transformed spectrum [1]. Fourier transform of EXAFS spectra for FeMnAl alloys exhibits the local ordering of Fe central atom which was change with increase of milling time. The first shell of Fourier transformed spectra was shifted to short atomic range corresponding to the formation of alloy. The Mössbauer spectrum showed typical sextets in the 1 hour milled sample corresponding to alpha-Fe spectrum. Increasing the milling time, the sextets became broader due to appearance of disordered Fe atoms in both solid solutions. The hyperfine field distributions were decreased as increasing milling time, which is similar trend with magnetization distribution.

[1] Yong-Goo Yoo, Bingzhi Jiang, J.M. Greneche, Dong-Seok Yang and Seong-Cho Yu *J. Magn. & Mag. Mat.*, 304, e715 (2006)

M-P-059

Structural and magnetic properties of NiAlC nano-powders

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We have studied the structure and magnetic properties of NiAlC nano powders made by mechanical alloying. The mechanical alloying was performed from 1 hour to 12 hours using Ni, Al, C element powders. Carbon added magnetic alloys have been extensively studied due to their nanocomposite structure originating from a complicated phase change due to carbon concentration [1]. The structural evolution during mechanical alloying was examined by extended X-ray absorption fine structure (EXAFS) and X-ray diffraction (XRD) analysis. The magnetic properties also have been measured by vibrating sample magnetometer (VSM). The XRD analysis confirmed the beginning of the alloy formation at 4 hours milling time and the completion of alloy formation after 12 hours milling time. From the XRD result, the estimated particle size was around 5 nm for 12 hours milled sample. The local structural change was analyzed by EXAFS measurement. The increase of milling time generates the absence of the long range ordering in NiAlC nano powders. The nearest neighbors of Ni atom were changed from Ni to Al or C with increasing milling time. This indicates that the NiAlC alloy was formed after 12 hrs milling time. The structural change leads to the variation of magnetization. The increase in milling time produces the decrease of magnetization.

[1] Yong-Goo Yoo, Dong-Seok Yang, Bingzhi Jiang, Seong-Cho Yu, and J.M. Greneche *J. Kor. Phys. Soc.*, 48(6), 1463 (2006)

BHALLA G.L. S-O-006, S-P-107
BHAT S.V. S-P-077
BHATIA M. S-I-010
BHATTI K. P. M-P-056
BIANCOUNI A. S-O-002
BILGILI O. S-P-096
BIRLIK I. S-P-028
BIRLIKSEVEN C. S-P-010
BIŠKUP N. M-P-041
BOGER A. S-I-049
BOGUSH V. M-I-002
BOHNENSTIEHL S. S-I-044
BOLAT S. S-P-076, S-P-079
BONDINO F. M-P-024
BORGES R.P. M-O-006, M-O-023
BOSE E. M-P-014
BOSE S. S-P-081
BOUGHERIRA Y. S-O-030
BOURÉE F. M-P-025
BOUSLYKHANE K. M-P-045
BOUSMINA M. M-P-045
BOYDEDAEV S.R. M-P-009
BOZBEY A. S-I-005, S-P-002, S-P-003
BOZHKO A. M-O-005
BRACCINI V. S-I-016
BRANDLMAIER A. S-I-049
BRANDT E. H. S-I-006
BROIDE E. S-O-013
BROTO J. M-P-025
BUCHELNIKOV V.D. M-O-003
BUD'KO S. L. S-I-007, S-I-035, S-I-047
BULAEVSKII L. S-I-027
BURZO E. M-O-012
BUZDIN A. M-I-003
BYCHKOV I.V. M-O-003
CAI C. S-P-029
CAKMAKTEPE S. M-P-010
CAMPBELL A.M. S-I-008
CAMPBELL A.S. S-I-012
CANFIELD P. C. S-I-035
CANSIZ A. S-O-003, S-P-105
CAO S. S-P-029
CARDWELL D. A. S-I-011
CARLESCHI E. M-P-024
CARLSON S. S-P-032
CASACA A. M-O-006
CASANOVA F. M-O-036
CELEBI S. S-I-013, S-O-041, S-P-014, S-P-015, S-P-026, S-P-027, S-P-098
CELENTANO G. S-P-004
CELIK E. M-P-007, M-P-039, M-P-064, S-P-028
CELIK S. S-P-045, S-P-082, S-P-088
CETINKARA H.A. S-P-053
CHAN C. L. M-P-014
CHAND M. S-P-066
CHATTERJEE A. M-I-004, M-O-027
CHAUDHARY S. M-O-028, M-P-056
CHAUDHURI B. K. M-P-014
CHAUHAN C. C. M-O-034
CHEGGOUR N. S-I-009
CHEIKHROUHOU A. M-O-010, M-P-022, M-P-023
CHEN J.M. S-P-023
CHEN M. S-P-029
CHEN Y.G. M-I-015
CHEN W.M. M-I-019
CHILOTTE C. M-O-036, S-P-085
CHOCKALINGAM S.P. S-P-066, S-P-077, S-P-081
CHOI I. S-O-009
CHOI H.-S. S-O-019
CIMBERLE M.R. S-P-009
CIONTEA L. S-P-004
CIRELI A. M-P-007
CIRILLO C. S-O-008
CITCI S. M-P-057
CLAUS H. M-I-008
COLDEA M. M-P-029, M-P-061
COLDEA R. S-P-068
COLLINGS E.W. S-I-010, S-I-044
COSKUN A. S-P-025
COSKUN I. M-P-063
COSTA A.T. M-O-023
CRISANI A. S-I-001, S-I-011
CROITORU M. D. S-I-039
CRUZ M.M. M-O-023
CUBITT R. S-I-012
CULHA O. S-P-028
CVETKO D. M-O-013
DALCHIELE E.A. M-P-055
DANG V. S. S-I-001, S-I-011
DANCER C. E. J. S-I-020
DAROCA D.P. M-O-036, S-P-085
DAS D. M-P-012
DAŞ P. S-P-065
DA SILVA R. C. M-O-006, M-O-023
DEAC I. M-P-029
DEAC I.G. M-O-012
DEDE M. M-O-020, M-P-050, S-P-047
DE KEYSER K. S-I-040
DE LUCA R. S-O-032
DEMIREL E. M-O-032, M-P-047
DEPPE F. S-I-040
DESOKY AND S. S-P-054
DEUTSCHER G. M-P-008, S-P-018
DEWHURST C.D. S-I-012
DHAWAN M. M-P-044
DIEZ J.C. S-I-041, S-P-040
DIKO P. S-O-024, S-O-025
DILLEY N. S-I-050
DIMITROV D. M-O-016
DJUHANA D. M-O-004, M-O-029, M-P-054
DOBROWOLSKI V. M-P-027
DOGAN N. M-O-022, M-P-042, M-P-055, S-P-056, S-P-063
DOGAN O. S-P-052, S-P-066
DOLLA S.N. M-P-044
DOLL D. S-I-044
DOMINKO R. M-O-022
DOROSINSKII L. M-P-028
DOS SANTOS D. I. S-O-011
DOU S. S-I-042
DOW J. D. S-I-013
DRAGIEVA I. M-O-017
DUBONOS S.V. S-I-032
DUC T. H. S-O-043
DUKHNENKO A.V. M-P-060
DURRELL J.H. S-O-035
DUZ I. S-P-052, S-P-060
DUZGUN I. S-I-013, S-P-014, S-P-015, S-P-026, S-P-027, S-P-098
DYACHENKO O.A. S-P-058
D'YACHUK V.V. M-O-005
DZHUMANOV S. S-P-069, S-P-092
EGE Y. M-P-063

ESTERER M.	S-I-015
EKIN J. W.	S-I-009
ELMASSALAMI M.	S-O-017
EMHOFER J.	S-I-015
ERDEM R.	M-P-050
	M-P-068
EROL M.	M-P-039
	M-P-064
EROL M.	M-P-048
ERTUGRUL M.	S-P-036
ESCOFFIER W.	S-I-032
FAIZ M.	S-O-040
	S-P-037
FARAHMANDJOU M.	M-P-034
FARDMANESH M.	S-P-002
	S-P-003
FEDORCHENKO I.V.	M-P-027
FEDORENKO V.V.	S-P-030
FELNER I.	M-I-005
FENG Q.-R.	S-O-031
FENG X.	S-O-020
FERDEGHINI C.	S-I-016
	S-P-009
FERREIRA P.	M-O-006
FERRETTI M.	S-P-009
FIORY A. R.	S-I-014
FLÜKİGER R.	S-I-017
FORGAN E.M.	S-I-012
FRAERMAN A.A.	M-O-035
FRANK A.	S-I-019
FRIDMAN Y.A.	M-O-031
FU D.J.	M-P-017
FU X. K. (BOB)	M-I-019
FUJII H.	S-O-037
FUJIMAKI A.	S-I-005
FUJIKAWA R.	M-I-011
FURUKAWA Y.	S-I-028
GALLUZZI V.	S-P-004
GAMBARDELLA U.	S-P-004
GAMZATOV A.G.	M-O-003
GANIEV O.K.	S-P-092
GARG K.B.	M-P-024
	M-P-044
	S-P-032
GARIFULLIN I.A.	M-I-006
GAUR S.	M-P-044
GELANDE C.	S-P-081
GELIR A.	M-P-071
GENCER A.	M-O-009
	M-P-040
	M-P-073
	M-P-075
	S-O-004
	S-P-064
	S-P-108
GEPRÄGS S.	S-I-049
GERBALDO R.	S-O-015
	S-P-033
GERBER A.	M-O-004
GEURTS R.	S-O-033
GHANNAM A.	S-O-040
	S-P-031
GHARAIBEH M.	S-O-022
	S-P-042
GHATTAS A.	S-O-014
	S-P-013
GHAZANFARI N.	M-P-015
	S-O-004
GHEISARI M.	M-P-072
GHEISARI KH.	M-P-020
GHIGO G.	S-O-015
	S-P-033
GILLIJNS W.	S-I-040
GIUNCHI G.	S-P-033
GLOTER A.	M-O-013
GLOWACKI B.A.	S-I-018
GODINHO M.	M-O-006
	M-O-023
GOKAY U.S.	S-P-084
GOLDACKER W.	S-I-019
GOLDMAN A.I.	M-O-024
GOLOD T.	S-O-005
GOMEZ P. H.	M-P-036
GÖMÖRY F.	M-I-007
	M-P-035
GONCALVES A. P.	M-O-006
GÖNNENWEIN S.T.B.	S-I-049
GOODRICH L. F.	S-I-009
GOPINADHAN K.	M-O-028
GORDON R.	S-I-035
GORUR O.	S-P-061
GORYUNOV YU. V.	M-P-060
GOSHCHITSKII B.N.	S-P-030
GOTO T.	M-I-011
GOURGY S. H.	M-P-008
GOYAL S.C.	S-P-078
GOZUAK F.	M-P-065
GOZZELINO L.	S-O-015
	S-P-033
GRASSO G.	S-O-034
	S-O-045
	S-P-108
GRAY E.M.	M-P-030
GRAY K.E.	M-I-008
	S-I-025
	S-I-033
GRIBKOV B.A.	M-O-035
GRIGORIEVA I.V.	S-I-032
GRITZNER	S-O-028
GROSS R.	S-I-048
	S-I-049
GROVENOR C.R.M.	S-I-020
	S-I-050
	S-P-045
GROVER A.K.	M-P-047
	S-P-065
GSELL S.	M-I-016
GUCLU N.	S-P-104
	S-P-108
GUCUMAN Y.G.	S-P-052
	S-P-060
GULER E.	M-P-026
GULER G.	M-P-074
GULER S.	M-O-030
GUNEL H.Y.	S-P-019
GUNER S.	M-P-055
GUNGUNES H.	M-P-026
GUNGOR E.	S-O-012
GUPTA A.	M-I-009
GUPTA S.	S-P-078
GURBUZ A.	M-P-007
GURUSWAMY P.	S-I-042
GUSEINOV G.G.	M-P-062
GUSEV S.A.	M-O-035
GUSHOU S.	M-P-004
GUTIERREZ J.	S-I-034
GUVEN K.	M-P-026
HABERMEIER H.-U.	M-I-010
HALLET X.	S-O-038
HAMDAN N. M.	S-I-021
HAMEDOUN M.	M-P-045
HAMET J.F.	S-O-030
HAMPSHİRE D. P.	S-I-022
HANASATO A.	S-I-002
HARSHMAN D. R.	S-I-014
HARUYAMA J.	S-I-023
HASAN (QASEER) M.K.	S-O-022
	S-P-042
HASANAIN S.K.	M-P-018
HASANPOUR A.	M-P-033
HASCICEK Y.S.	S-I-051
	S-P-041
HATA Y.	S-O-037
HATTORI T.	S-I-025
HÉBERT S.	M-P-025
HEINONEN M.	M-P-024
HENANDEZ M. G.	M-P-041
HEO C.-M.	M-P-059
HERNANDEZ A. D.	S-O-016
HERVIEU M.	M-P-025
HINKS D. G.	S-I-033
HIRATA K.	S-O-017
HORN S.	M-I-016
HORZUM N.	S-P-055
	S-P-072
HOSEINI M.	S-P-003
HOSHIKAWA A.	S-O-037
HOURMATALLAH A.	M-P-045
HSEU H.S.	S-P-023
HU X.	S-I-025
HUHTINEN H.	S-O-024
HUSNUTDINOV R.R.	M-P-042
HWANGBO C.K.	S-P-099
ICHKITIDZE L.P.	M-O-019
	S-P-034
	S-P-039
	S-P-048
ILIC B.	S-I-040
INAM H.	M-O-026
INANIR F.	S-P-014
	S-P-015
	S-P-026
	S-P-027
INOUE M.	M-I-011
IQBAL M. J.	M-P-031

	M-P-036
IRJALA M.	S-O-024
ISAKOV G.I.	S-P-017
	S-P-074
ISHAQUE M.	M-P-070
ISLAM A.K.M.A.	S-I-024
ISLAM M.U.	M-P-070
ISLAM R.S.	S-P-071
ISNARD O.	M-P-011
JAGLIČIČ Z.	M-O-013
JAVADPOUR S.	M-P-020
JESUDASAN J.	S-P-066
JIN G.	S-P-029
JIRSA M.	S-O-026
JO Y.	S-O-043
JOHN J.	S-P-102
JOSHI N.	M-O-011
JOTANIA R.B.	M-O-034
JUN S.-H.	M-O-029
	M-P-054
JUNG C. U.	S-O-009
JUNG M.-H.	S-O-043
KADOWAKI K.	S-I-025
	S-I-033
	S-I-052
KAKEYA I.	S-I-052
KAKI A. AIT	S-P-049
KALENDER O.	M-P-063
KALKAN B.	S-O-007
KALT H.	M-O-011
KAMELI P.	S-O-023
KANG B.	S-O-043
KANG B.-W.	M-O-025
KANG T. W.	M-P-017
KAŇUCHOVÁ M.	S-O-028
KAO H.-C. I.	S-P-023
KARACA I.	S-P-101
KARATAS S.	M-P-074
KARCI A.B.	S-P-006
KARKIN A.E.	S-P-030
KARPINSKI J.	S-I-026
	S-P-054
KARTOP U G.	M-P-069
KASAHARA S.	S-O-017
KASHYAP S. C.	M-O-028
	M-P-056
KATRYCH S.	S-I-026
	S-P-054
KAVAS H.	M-O-001
	M-O-033
KAVEČANSKÝ V.	S-O-028
KAZAN S.	M-O-026
	M-P-049
	M-P-055
KAZHEVA O.N.	S-P-058
KEALEY P.G.	S-I-012
KECHIK A. M. M.	S-I-011
KERIMOVA T.G.	M-P-019
KERVAN N.	M-P-040
	M-P-073
	M-P-075
KERVAN S.	M-P-040
	M-P-073
	M-P-075
KHAIBULLIN R.	M-O-021
	M-O-030
KHALID W.	M-P-018
KHAN M. A.	M-P-070
KHAN S.A.	M-P-012
KHANOV L.N.	M-O-003
KHAPAEVA T. M.	M-O-018
	M-P-027
KHARMOUCHE A.	M-P-021
KHOSHAMAN A. H.	S-P-003
KHOVAILO V.V.	M-O-003
KHUDAYBERDIEV Z.S.	S-P-092
KILANSKI L.	M-P-027
KILIC A.	S-O-004
	S-P-108
KIM D.-H.	M-O-014
	M-O-025
	M-O-029
	M-P-054
KIM H.J.	S-P-020
KIM H.-J.	S-O-043
KIM H. M.	S-P-022
	S-P-106
KIM S.H.	S-P-020
KIM Y.C.	S-P-106
KISHAN H.	M-P-003
	S-I-003
	S-O-006
	S-O-024
	S-P-005
	S-P-107
KITAZAWA H.	S-O-037
KLEVETS P.N.	M-O-031
KLIMOV A.Y.	M-O-035
KLING A.	S-I-019
KOCABAS K.	S-P-096
KOH D. W.	M-P-017
KOKABI A.	S-P-003
KOLEDOV V.V.	M-O-003
KOLEMEN U.	S-O-041
	S-P-014
	S-P-101
KONDOH N.	S-I-028
KOPARAN E. T.	S-I-050
KORKMAZ M.	M-P-016
KOROLEVA L.I.	M-O-018
	M-P-027
KOSEOGLU H.	S-I-033
	S-P-016
	S-P-021
KOSEOGLU Y.	M-O-001
	M-O-033
	M-P-065
KOSHELEV A. E.	S-I-025
	S-I-027
	S-I-033
KOUBAA M.	M-O-010
	M-P-022
	M-P-023
KOUBAA W. C.	M-O-010
	M-P-022
	M-P-023
KOVÁČ J.	S-O-028
KOVÁČ P.	S-O-029
KOYAMA T.	S-I-025
KRAMER R.	S-I-040
KRASNOV V.M.	S-O-005
KREYSSIG A.	M-O-024
KRZYMANSKA B.	M-P-027
KUCUKOMEROGLU T.	S-P-027
KUDYMOW A.	S-I-019
KULRIYA P.K.	M-P-012
KUMAGAI K.	S-I-028
KUMAR A.	M-P-003
	S-P-005
KUMAR S.	M-P-044
KUPRIYANOV M.Y.	M-I-016
KURBAKOV A.	M-P-025
KURBANOV U.T.	S-P-092
KURTER C.	S-I-025
	S-I-033
KUTUK S.	S-P-076
KWOK W. K.	S-I-025
	S-I-033
KWON W.S.	S-P-106
KWON Y.-K.	S-P-022
	S-P-106
LAIHO R.	S-O-024
LANG W.	S-I-029
LAPPAS A.	M-O-013
LAVIANO F.	S-O-015
	S-P-033
LEE B.W.	S-O-009
LEE E.Y.	S-P-106
LEE H.-S.	S-O-043
LEE J.D.	S-P-106
LEE S. H.	M-P-054
LEE S.-I.	S-O-043
LEE S.L.	S-I-012
LEE S.W.	M-P-017
LEIBOVITCH G.	S-P-018
LI C.-P.	M-O-036
LI Q.	M-I-008
LI Q.	S-I-033
LI Y.	S-O-020
LI Z.	S-P-020
LI Z.Z.	S-P-044
LIN S.	S-I-025
LING D.C.	S-P-023
LOFFLER W.	M-O-011
LOHNEYSEN H.V.	M-O-011
LOPARDO G.	S-O-015
	S-P-033
LOPATIN O.N.	M-O-030
LOVCHINOV V.	M-O-016
LUN Y.K.	M-P-066
LUNG C.	S-P-068
LYONS D.	S-I-044
LYU K.-K.	M-O-025

	S-O-043
[illegible]	S-P-020
[illegible]	M-P-018
[illegible]CHEDA M.	S-I-025
[illegible]CRE M.A.	S-I-041
	S-P-040
[illegible]GALHÃES S.	M-O-023
[illegible]GNANO E.	M-P-024
[illegible]GNAN A.	M-P-025
[illegible]JOROS M.	S-I-018
[illegible]JKIC G.	S-I-036
[illegible]KAROVA T.L.	M-P-055
[illegible]KSIMOVA G.M.	M-P-042
[illegible]LAGOLI A.	S-I-016
[illegible]NCINI A.	S-P-004
MANFRINETTI P.	S-I-016
	S-P-009
MANGALARAJ D.	M-P-028
MANI D.K.	S-P-051
MANIOS E.	M-O-015
	M-P-013
MANOLACHE S.	S-P-073
MANOUCHEHRI S.	M-P-032
MARCONI D.	S-P-043
MARENKIN S.F.	M-P-027
MARIANTONI M.	S-I-048
MARKOWITSCH W.	S-I-029
MARTIN C.	S-I-035
MARTIN C.	M-P-025
MARTINELLI A.	S-I-016
	S-P-009
MARTINEZ E.	S-I-041
MARUYAMA S.	S-I-023
MARX A.	S-I-048
MASOUDI H.	S-O-023
MASROUR R.	M-P-045
MASSIDDA S.	S-I-030
MATEI I.	S-P-044
	S-P-073
MATSUDA Y.	S-I-028
MATSUMOTO H.	S-I-025
MATSUSHITA Y.	S-O-037
MAZOV L. S.	S-O-021
MCINTYRE P.	M-I-019
MÉCHIN L.	S-O-030
MEENA R.S.	S-P-005
MENGHINI M.A.	S-I-040
MENO T.	S-I-048
MENZEL E.	S-I-048
MERGEN A.	M-P-005
	M-P-006
MERZLIKIN A.	M-I-011
METLUSHKO V.	S-I-040
METSKHVARISHVILI I.	S-P-089
	S-P-091
METSKHVARISHVILI M.	S-P-089
	S-P-091
MEYNERS D.	M-I-014
MEZZETTI E.	S-O-015
	S-P-033
MIAH M. I.	M-P-030
MIHALACHE V.	S-P-047
MIKHAILOV G.G.	M-O-003
MIKHEENKO P.	S-I-001
	S-I-011
	S-I-020
MILOŠEVIĆ M. V.	S-I-031
	S-O-033
MINAMI H.	S-I-025
MINETTI B.	S-O-015
	S-P-033
MISKO V.R.	S-I-032
MITCHELL J.F.	M-I-008
MIYAJIMA S.	S-I-005
MIYAZAKI T.	M-O-022
MOCHIKU T.	S-O-037
MOJUMDER M.A.	S-P-050
MONTICONE E.	S-O-015
MORA DE LA P.	S-O-027
MORCHSHAKOV V.	M-P-038
MOREIRA M.D.	M-O-023
MOSHCHALKOV V.V.	S-I-040
	S-O-038
MOFTAKHARZADEH A.	S-P-003
MOSBAH M.-F.	S-P-049
MOZAFFARI M.	M-P-032
	M-P-033
	M-P-072
	S-O-023
MOZZHUKHIN G.V.	M-P-042
MUDGEL M.	S-O-006
	S-P-005
	S-P-107
MUKHOPADHYAY S.	M-O-027
MÜLLER C.	M-I-016
MUMTAZ A.	M-P-018
MURAKAMI M.	M-O-007
MURALIDHAR M.	S-O-026
MUSTAFAYEVA K.M.	M-P-019
MUTLU Z.	S-P-052
	S-P-060
NADOEVA I.	S-P-089
	S-P-091
NANDI S.	M-O-024
NANE O.	M-O-009
NAQIB S.H.	S-P-071
NARLIKAR A. V.	S-O-024
NARSALE A.M.	S-P-102
NATARAJ D.	M-P-028
NAVARRO O.	S-O-027
NAZLIBILEK S.	M-P-063
NEFEDOV A.	M-O-021
NEUMANN M.	M-P-029
	M-P-061
NEZIR S.	S-P-070
NIARCHOS D.	M-O-015
	M-P-013
NIEMCZYK T.	S-I-048
NIYAIFAR M.	M-P-072
NORDBLAD P.	S-P-032
NOVOTORTHEV V.M.	M-P-027
NOZDRIN Y. N.	M-O-035
NURGALIEV T.	S-P-010
NURSOY M.	S-P-024
	S-P-053
	S-P-061
OBAIDA M.	M-O-026
OBEIDAT A.	M-P-001
OBAIDAT I.M.	S-O-022
	S-O-036
	S-P-038
	S-P-042
OBERMEIER G.	M-I-016
OBRADORS X.	S-I-034
OH J. T.	M-P-020
OH S.-K.	M-O-014
	M-O-029
	M-P-054
	M-P-059
OKUR S.	S-P-055
	S-P-072
	S-P-075
OKUR S.	S-O-034
	S-P-075
ONAR N.	M-P-007
ONBASLI U.	S-P-062
	S-P-087
OOGANE M.	M-O-022
OPEL M.	S-I-049
ORAL A.	M-O-020
	M-P-051
	S-P-047
OSBORN R.	M-I-008
OSOKIN D.Y.	M-P-042
OYAIZU T.	S-I-028
OZABACI M.	S-P-093
OZCELIK B.	M-O-009
OZDAS E.	S-O-007
	S-O-012
OZDEMIR I.	M-P-007
OZDEMIR M.	M-O-026
OZDEMIR M.	S-P-046
OZDEMIR Z.G.	S-P-062
	S-P-087
OZGEN T.	S-P-055
	S-P-072
OZKAN H.	S-O-004
	S-O-018
OZKIRIM I.	M-P-016
OZKURT B.	M-O-009
OZMEN L.	M-P-040
OZTURK A.	S-P-026
	S-P-027
	S-P-098
OZTURK K.	S-P-045
	S-P-082
	S-P-088
OZTURK O.	S-P-053
	S-P-064
OZTURK R.	S-P-097
OZTURK Y.	M-P-039
	M-P-064

OZYUZER L.	S-I-025
	S-I-033
	S-O-034
	S-P-016
	S-P-021
	S-P-046
PAI S.P.	S-P-102
PANDYA D. K.	M-O-028
	M-P-056
PALAU A.	S-I-034
PALENZONA A.	S-I-016
	S-P-009
PALLECCHI I.	S-I-016
PANAGIOTOPOULOS I.	M-P-013
PARDO E.	M-I-007
PARHIZGAR S. S.	M-P-034
PARK C. J.	M-P-017
PARK H. J.	S-P-106
PARK M.-S.	S-O-043
PARMIGIANI F.	M-P-024
PARVIN F	S-I-024
PASQUINI G.	M-O-036
	S-P-085
PATURI P.	S-O-024
PEDARNIG J. P.	S-I-029
PEETERS F.M.	S-I-032
	S-I-039
	S-O-016
	S-O-033
PEKERTEN B.	S-P-019
PERINI E.	S-P-033
PETRISOR T.	S-P-004
PHILLIPS J.	S-I-044
PIAO H.	M-O-014
	M-O-029
	M-P-054
PINTO R.	S-P-102
PIRAUX L.	S-O-038
PISSAS M.	M-O-015
POMAR A.	S-I-034
POP A.V.	S-P-043
	S-P-068
	S-P-073
POP M.	S-P-068
POP V.	M-P-011
	M-P-061
	S-P-073
PORTESI C.	S-O-015
PREGELJ M.	M-O-013
PRISCHEPA S.L.	S-O-008
PROBERT M.	M-I-012
PROVENZANO V.	M-I-015
PROZOROV R.	S-I-035
	M-O-024
PU M.H.	S-P-109
PUIG T.	S-I-034
PUTIN G.	M-O-005
PUTTI M.	S-I-016
	S-P-009
PUZNIAK R.	S-I-026
QIN W.	S-O-020
QIN Z.G.	S-P-029
QURESHI A.	M-P-005
	M-P-006
RADULOV I. A.	M-O-016
RAFFY H.	S-P-044
RAKOTO H.	M-P-025
RAMAKRISHNAN S.	S-P-065
RAMEEV B.Z.	M-I-013
	M-O-030
	M-P-042
	M-P-049
	M-P-053
RAMES M.	S-O-026
RAO A.M.	S-I-023
RAQUET B.	M-P-025
RASEKH SH.	S-I-041
	S-P-040
RAYCHAUDHURI P.	S-P-066
	S-P-081
RAZMKHAH S.	S-P-003
RAZUMOVSKAYA O.N.	M-O-002
REDNIC L.	M-P-029
	M-P-061
REDNIC V.	M-P-029
	M-P-061
REISS G.	M-I-014
REZNICHENKO L.A.	M-O-002
RINDFLEISCH M.	S-I-044
RISS O.	M-O-004
ROGACKIAND K.	S-I-026
ROGOV V.V.	M-O-035
ROMANO G.	S-I-016
ROSA M..A.	M-O-006
ROSENKRANZ S.	M-I-008
ROSENSTEIN B.	S-P-007
RUFOLONI A.	S-P-004
RUTTER N.A.	S-O-035
RYAZANOV V.V.	M-I-016
RYDH A.	S-O-005
RYU K.	S-P-020
SAEKI M.J.	S-O-011
SAFRAN S.	S-P-108
SAGSOZ M.E.	S-P-036
SAHIN O.	S-P-101
SAHINGOZ R.	M-P-048
SAITO S.	S-I-023
SAITO S.	S-I-048
SAITOVITCH E.	M-P-044
SAKURABA Y.	M-O-022
SALAMA K.	S-I-036
SALAZER J.S.	M-P-028
SALEM A.F.	S-O-002
	S-O-040
	S-P-031
	S-P-037
SALEM M. B.	S-P-013
	S-P-051
SALLUZZO M.	S-I-037
SAMOKHVALOV A.V.	M-O-035
SANDIER E.	S-P-080
SARAIVA A.	M-O-006
SARANGI S.	S-P-077
SARIKURKCU C.	S-P-025
SARKAR A.	S-I-001
	S-I-011
SATO K.I.	S-I-038
SAVASKAN B.	S-P-088
SCHAEFERS M.	M-I-014
SCHLACHTER S.I.	S-I-019
SCHMIDT C.	S-I-019
SCHRECK M.	M-I-016
SCHULLER I. K.	M-O-036
SEBT S. A.	M-P-034
SEDKY A.	S-P-094
SEDOV V.L.	S-O-042
SEİLER E.	M-I-007
SEMBA K.	S-I-048
SENATORE C.	S-I-017
SEONG K.C.	S-P-020
SERFATY S.	S-P-080
SERTKOL M.	M-O-001
	M-O-033
SHANENKO A. A.	S-I-039
SHAPIRO A.J.	M-I-015
SHARMA P.	M-O-034
SHAVROV V. G.	M-O-003
SHIM J.-H.	M-O-029
SHINOHARA H.	S-I-023
SHISHIDO H.	S-I-028
SHITSEVALOVA N.YU.	M-P-060
SHTRIKMAN H.	S-P-047
SHULL R.D.	M-I-015
SIDDIQUAH M. R.	M-P-031
SIDORENKO A.	M-I-016
SILHANEK A.V.	S-I-040
SIMSEK Y.	S-I-033
	S-P-016
	S-P-021
SINGH A.	M-O-011
SINGH F.	M-P-012
SINGH R. P.	M-P-047
SINGH S.K.	M-P-003
	S-P-005
SINGHAL R.K.	M-P-044
SIRI A.S.	S-P-009
SOHRABI M.	S-O-001
SOKOLOV B.Y.	M-P-009
SOLANO E.	S-I-048
SOLOVYOV N.	M-I-007
SONG X.	S-O-020
SOTELO A.	S-I-041
	S-P-040
ŠOUC J.	M-I-007
	M-P-035
SOUNDARARAJAN D.	M-P-028
SOZERI H.	M-P-015
	M-P-071
	M-P-075
	S-P-006
	S-P-108
SPELLER S.C.	S-O-035
STAMOPOULOS D.	M-O-015
	M-P-013
STIUFIUC G.	S-P-043

SUBASI H. M-P-042, M-P-053
SUMPTION M. S-I-044
SUMPTION M.D. S-I-010
SURGERS C. M-O-011
SUSNER M. S-I-044
SUSNER M.A. S-I-010
SUZER S. S-O-007
SUZUKI A. M-O-007
SYAMAPRASAD U. S-I-042
SZYMCZAK R. M-P-027

TABET N. S-P-037
TACHIKI M. S-I-025, S-I-043
TAGIROV L. M-O-021
TAGIROV L.R. M-I-016
TAKAYANAGI H. S-I-048
TAKEYA H. S-O-017, S-P-065
TANATAR B. S-P-067
TANG J. S-O-020
TANG J. S-O-020
TANOGLU M. S-O-034
TAO B. S-O-020
TARANTINI C. S-I-016
TARI S. S-O-034
TARIGAN K. M-O-025, M-P-059
TASKAEV A.S. M-O-003
TEMPFLI M. M. S-O-038
TEMPFLI S. M. S-O-038
TEPE M. S-P-006, S-P-084
TERZIOGLU C. S-P-008, S-P-024, S-P-053, S-P-061, S-P-064
TESEAN R. M-O-012
THALMAIER G. S-P-004
THEMONT Y. S-O-030
THOMAS A. M-I-014
THUECKS R. M-I-016
TIMI B.D. S-P-007
TIRCO R. I. S-I-020
TOGANO K. S-O-017
TOMSIC M. S-I-044, S-I-051
TOMT C.V. M-P-047, S-P-065
TONGOC B.T. M-P-057
TOPAL U. S-P-010, S-P-083
TOPALI M. S-P-028
TOPCAYA R. M-P-042, M-P-053
TOPLAK M. M-O-033
TOZAN S. S-P-019
TRIPATHI B. M-P-012
TRIPATHI V. S-P-066
TROPEANO M. S-I-016, S-P-009
TROYANCHUK I.O. M-P-038
TRUNIN M.R. S-O-025
TSUJİMOTO M. S-I-025
TULUN M. M-P-071
TUNYAGI A. R. M-P-061
TURKOGLU F. S-I-033, S-P-016, S-P-021
UMEK P. M-O-013
UMMARINO G.A. S-P-033
USHERENKO S. S-P-017, S-P-074
UZUN O. S-O-041, S-P-101, S-P-104
VAJPAYEE A. S-O-006, S-P-005
VANACKEN J. S-O-038
VANNETTE M. D. S-I-035, M-O-024
VANNOZZI A. S-P-004
VARGHESE N. S-I-042
VARILCI A. S-P-008, S-P-061
VDOVICHEV S.N. M-O-035
VENEZUELA P. M-O-023
VENKATESHVARAN D. S-I-049
VERBENKO I.A. M-O-002
VERELLEN N. S-I-040
VERMEULEN H. S-O-044
VIGNOLO M. S-I-016
VIJAY Y.K. M-P-012
VILLEGAS J.E. M-O-036
VINCKX W. S-O-038
VINNIKOV L.Y. S-I-032
VINOD K. S-I-042
VINOGRADOV A. M-I-011
VODOLAZOV D.Y. M-P-042
VOJENČIAK M. M-I-007, M-P-035
VOYTENKO A.P. M-O-031
WANCHOO S.K. S-P-102
WANG Y.-B. S-O-031
WEBER H. W. S-I-015
WEIGAND M. S-O-035
WEILER M. S-I-049
WEISS K. S-I-019
WELP U. S-I-025, S-I-033
WEN H.-H S-I-045
WESTERHOLT K. M-O-026, M-P-049
WINKLER W. S-P-086, S-P-090, S-P-095
WONGSATANAWARID A. M-O-007
WUERNISHA T. S-O-037
XIA W. M-P-066
XING Y. M-P-044
XIONG J. S-O-020
XU B. S-I-032
YA Z. M-P-066
YAHYA A.K. S-P-001
YAKINCI M. E. S-I-052, S-O-041, S-P-010, S-P-056, S-P-063, S-P-093, S-P-097, S-P-100, S-P-103
YAKINCI Z.D. S-P-093, S-P-103
YAKUNIN M. S-O-013
YALCIN O. M-P-068, M-P-069
YAM J. H. S-P-023
YAMAGUCHI H. S-I-025
YAMAKI K. S-I-025, S-I-052
YAMAMOTO T. S-I-025, S-I-033
YAN J. M-O-024
YANG C.P. M-P-038
YANG H. D. M-P-014
YANMAZ E. S-I-050, S-O-041, S-P-045, S-P-076, S-P-079, S-P-082, S-P-088
YAO X. S-P-029
YASAR E. M-P-026
YASAR N. S-P-096
YASUOKA H. S-O-037
YAVUZ M. M-I-019
YEGEN D. S-P-008
YERLI Y. M-P-053
YI S.-Y. S-O-031
YIGIT A. M-P-002, M-P-058
YILDIRIM T. M-I-017
YILDIZ S. S-P-014
YILGIN R. M-O-022, M-O-026, M-P-049
YILMAZ F. S-P-101
YILMAZ M. S-P-052, S-P-060
YILMAZ S. M-P-048
YILMAZ Y. M-P-071
YILMAZLAR M. S-P-053, S-P-070
YONAMINE A.H. S-O-011
YOO Y.-G. M-O-025, M-P-059

YOON I. T.	M-P-017
YOUSEFI M. H.	M-P-032
YU S.-C.	M-O-014
	M-O-025
	M-O-029
	M-P-054
	M-P-059
YUCEL E.	S-P-012
YUE J.	S-I-044
ZABEL H.	M-O-021
ZANDRON O.S.	S-P-059
ZAOUI A.	M-I-018
ZASHCHIRINSKII D.M.	M-P-027
ZDRAVKOV V.	M-I-016
ZHAI Y.	S-P-109
ZHANG F.	S-O-020
ZHANG J.	S-P-029
ZHANG T.	M-I-015
ZHANG Y. D.	M-P-059
ZHAO H.	S-I-032
ZHAO Y.	S-P-109
ZHENG H.	M-I-008
ZHIGADLO N.	S-I-026
	S-P-054
ZIHLIF A.M.	M-P-004
ZIQ KH. A.	S-O-002
	S-O-010
	S-O-040
	S-P-011
	S-P-031
	S-P-037
ZOUAOUI M.	S-O-014
	S-P-013
	S-P-051

	Abstract Number
	S-O-008
	M-P-019
	S-I-001
	S-I-011
	S-I-020
	M-P-034
	S-P-019
	M-I-001
	M-P-037
	S-O-023
	M-P-062
	M-O-009
	M-P-075
	S-P-033
	M-P-042
	S-I-005
	S-P-057
	M-O-021
	M-O-026
	S-P-002
	M-P-034
	S-I-051
	M-P-058
	M-O-020
	M-P-051
	S-P-056
	S-P-063
	S-P-093
	S-P-097
	S-P-100
	S-P-103
	M-O-008
	M-O-017
	M-O-022
	M-O-030
	M-O-032
	M-O-033
	M-P-005
	M-P-006
	M-P-042
	M-P-049
	M-P-067
ALBAYRAK E.	M-P-002
	M-P-058
ALBISS B. A.	S-O-022
	S-O-036
	S-P-042
ALESSANDRINI M.	S-I-036
ALEXANDROV G.G.	S-P-058
ALIEV A.M.	M-O-003
ALIYEV Y.I.	M-P-062
ALI-ZADE R.A.	M-P-046
AL KHAWAJA U.	S-O-036
	S-P-038
ALMOG B.	M-P-008
AL-SAFADI D.	M-P-001
	S-P-011
AL- SAWALHA A.	S-P-094
AL-SHANGITI D. M.	S-O-010
ALSMADI A.M.	M-P-004
ALTHAMMER M.	S-I-049
ALTIN S.	S-P-093
	S-P-097
	S-P-100
	S-P-103
ALTSHULER T.S	M-P-060
ALTUG D.T.	M-P-010
ALTUNBAS M.	S-P-014
	S-P-015
ALVEROĞLU E.	M-P-071
ALY A.H.	S-P-099
AMAVEDA H.	S-P-040
AMEMIYA N.	S-I-002
AMIGHIAN J.	M-P-032
	M-P-033
	M-P-072
AMIRA A.	S-P-049
AMIROV A.A.	M-O-002
ANDO Y.	M-O-022
ANDRÉ G.	M-P-025
ANDREONE D.	S-O-015
ANDRÉS A. DE	M-P-041
ANGUREL L. A.	S-I-041
ANIS-UR-REHMAN M.	S-O-039
ANNABI M.	S-O-014
	S-P-013
	S-P-051
ANNAORAZOV M.P.	M-P-038
ANTAL V.	S-O-028
APOSTOLOV A.	M-O-016
ARAS E.	S-O-004
ARČON D.	M-O-013
ARDA L.	M-P-037
	S-P-035
	S-P-041
	S-P-063
ARMENIO A.A.	S-P-004
ASHIQ M. N.	M-P-036
ASKERBEYLI (TAGIYEVA) R.	S-P-067
ASKERZADE I.N.	S-I-046
ASLAN H.	S-P-025
ASLAN O.	S-P-062
	S-P-087
ATAOGLU S.	S-P-041
ATTANASIO C.	S-O-008
AVASTHI D.K.	M-P-012
AVCI I.	S-P-002
AVGIN I.	M-P-039
	M-P-064
AUGIERI A.	S-P-004
AWANA V.P.S.	M-P-003
	S-I-003
	S-O-006
	S-O-024
	S-P-005
	S-P-107
AYBAR H.S.	M-P-038
AYDIN H.	S-P-024
AYTEKIN O.	M-P-043
AYYUB P.	S-P-081
AZZOUZ F. B.	S-P-013
	S-P-051
BABAEI-BROJENY A.A.	S-O-001
BABAYEV A.M.	M-P-010
BABU N. H.	S-I-011
BADTALOV A.B.	M-O-002
	M-O-003
BAELUS B.J.	S-I-032
BAG O.	S-P-070
BAIK S. K.	S-P-106
BAKKALOGLU O.F.	M-P-074
BALASZ I.	M-P-029
BALCI Y.	S-P-056
	S-P-063
	S-P-093
	S-P-097
	S-P-100
	S-P-103
BANERJEE R.	S-P-081
BAO L.Z.	M-P-066
BARHOUM S.A.	S-O-022
BARNER K.	M-P-038
BARYSHEV A.	M-I-011
BASARAN A.C.	M-O-001
	M-O-032
	M-P-037
	M-P-055
	M-P-065
	M-P-069
BASOGLU M.	S-I-050
	S-P-045
	S-P-088
BASSANI E.	S-P-033
BATLOGG B.	S-I-026
BAYKAL A.	M-O-001
	M-O-033
	M-P-065
BAYRI A.	M-P-043
BECK R.	S-P-018
BEKERIS V.	M-O-036
	S-P-085
BELENLI I.	S-P-008
	S-P-012
	S-P-024
	S-P-057
	S-P-061
	S-P-108
BELL C.	S-O-008
BELODEDOV M.V.	S-P-034
BEN AZZOUZ F.	S-O-014
BEN SALEM M.	S-O-014
BENEA D.	M-P-011
BENKRAOUDA M.	S-O-036
	S-P-038
BENMAAMAR F.	S-P-049
BENYOUSSEF A.	M-P-045
BENZAKOUR N.	M-P-045
BERBARANI C. H.	M-P-062
BERDIYOROV G. R.	S-O-016
BERKER A. N.	S-I-004
BERNINI C.	S-I-016
BERNSTEIN P.	S-O-030
BEVAN A.	S-I-020

M-P-059

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BK21
The Physics Based Human Resources Development Program for the Next Generation Devices

Structural and Magnetic Properties of NiAlC Nano-Powders

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Introduction

Mechanical alloying (MA) has been used widely to prepare metastable phases such as supersaturated solid solution, amorphous phases and nanostructure powders, starting from a mixture of elemental components or inter-metallic compounds in many alloy systems [1,2]. This technique has been extensively used in inter-metallic compounds to prepare nano-crystalline structures [3].

In the last century, a large number of amorphous transition-metal-metalloid (TM-M) alloys have been extensively investigated for their structural, electronic and magnetic properties. The magnetism in TM-M alloys is far from being understood [4].

Metal-metalloid systems such as Fe-Si and Fe-C have been extensively studied for application to magnetic and electronic devices, recently [3]. The role of the metalloid such as C, Si on the magnetic properties has been studied in Fe-, Co-, and Ni- based binary systems [5].

Carbon added magnetic alloys such Fe-C or Co-C, which are commonly used in industry, have been extensively studied due to their complicated nano-composite structure originating on a strongly phase change dependent on the carbon concentration [6].

Experiment

$(Ni_{0.5}Al_{0.5})_{90}C_{10}$ metastable alloy was prepared by the mechanical alloy using a SPEX 8000 mixer and mill with stainless steel ball. The starting material was a mixture of pure Ni, Al, and C powders.

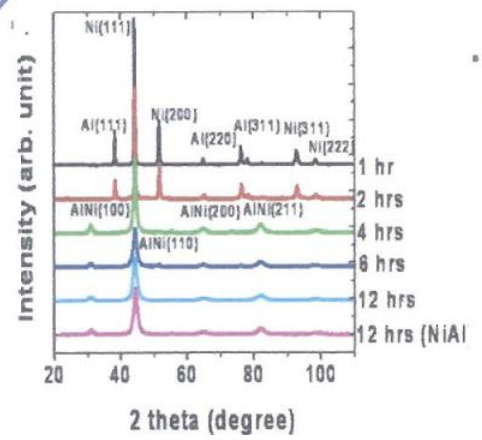
In order to study the alloying process, the milling time was varied from 1 hr to 12 hrs. The mechanical alloying was performed in Ar atmosphere to prevent oxidation during the alloying process. The ball to powder weight ratio was 20:1.

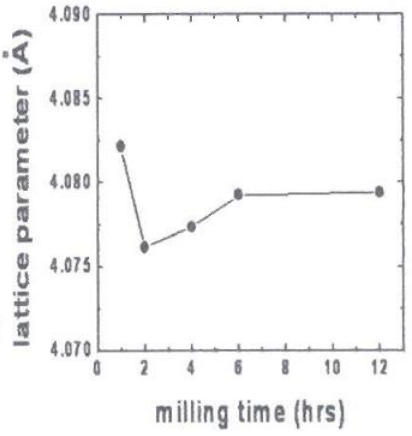
Magnetzation and coercivity of the samples were measured by using the vibrating sample magnetometer (VSM) with the maximum field of 1 kOe. The variations of structure were examined by XRD and EXAFS. XRD data were obtained with a monochromatic Cu-Kα radiation. Particle size was estimated by Scherrer formula from the XRD patterns.

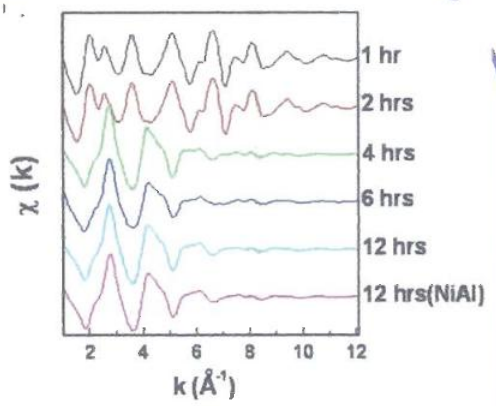
EXAFS experiments were carried out at the 3C1 EXAFS beam line of the Pohang Light Source (PLS) in the Pohang Acceleratory Laboratory. The PLS was operated with an electron energy of 2.5 GeV and maximum current of 200 mA.

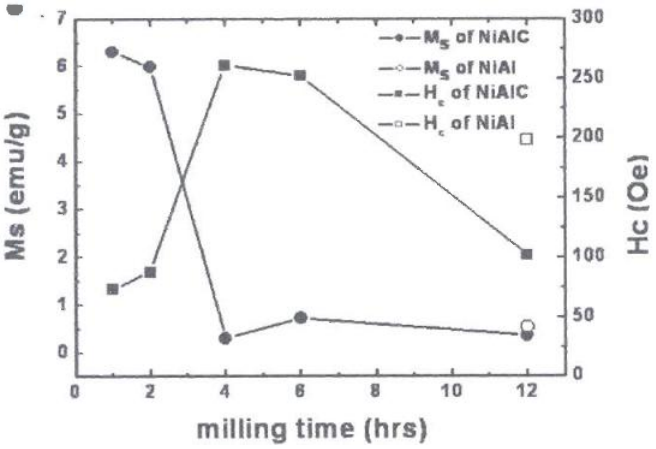
The EXAFS spectra were obtained at Ni K-edge (8346 eV) in the transmission mode at room temperature. The ion chambers were filled with the pure nitrogen gas. EXAFS data were analyzed with FEFF.

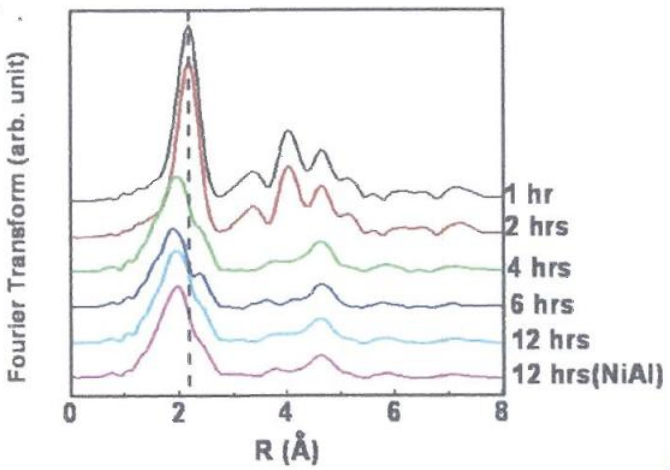
Results and discussions











Conclusions

Mechanically alloyed Ni45Al45C10 alloys for different times were studied by XRD, EXAFS and magnetization. In the initial stage of alloying time, the Ni and Al phase rapidly decreased. After 4 hrs milling time, structural phase showed fcc NiAlC structure and there is no long range ordering around Ni central atom. It means that the alloy was formed with nano-sized structure after 12 hrs milling time. The magnetization showed small value with compare to pure Ni which is occurred from magnetic dilution.

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