The International Seminar on Magnetic Materials (ISMM) 2013
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Shielding effectiveness study of Fe-Mn-Al Nanocrystalline and Amorphous Alloys

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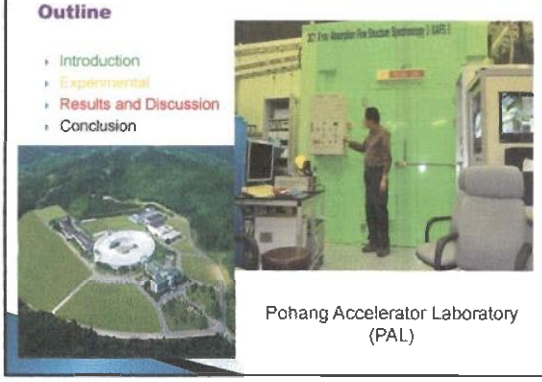
Outline

- Introduction
- Experimental
- Results and Discussion
- Conclusion



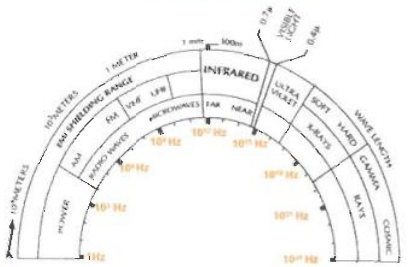
Pohang Accelerator Laboratory (PAL)

Introduction

In general, the effective electro/magnetic shielding requires very good soft magnets with very high magnetic permeability and low resistivity, thus it is also an important problem in the field of searching of new soft magnetic materials with unique properties. For shielding applications the best material in the examined group is that for which initial magnetic permeability (after optimization annealing) is the highest. J.G. Haneczok, et al., *Electro magnetic shielding effectiveness of soft magnetic $Fe_{40}Ni_{38}B_{18}$ amorphous alloys*, Journal of materials processing technology **209** (2009) 2356-2360

INTRODUCTION

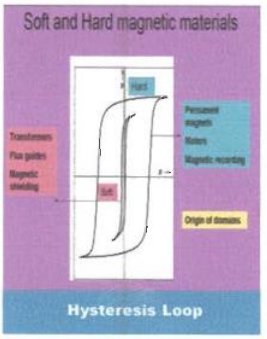
Electromagnetic Spectrum



Phase diagram of the ternary Fe-Mn-Al system [after Chakrabarti in 1977]

These alloys were obtained by melting in an arc furnace, and afterwards by heating them at 1000 °C and quenching in iced water.
The Fe-Mn-Al alloy system is intensively investigated because of the possibility of its application in stainless steels.
Although its structural and mechanical properties are well known, its magnetic properties have not been investigated in detail.
Magnetic properties of the Fe-Mn-Al system depend very strongly on the crystal structure, the phase composition, and on the degree of order.

- Nowadays, amorphous and nanocrystalline alloys magnetic materials have many applications in industrial products.
- The wide range applications of the materials arises from the versatile nature of these materials which can provide fast magnetization reversal with minimal magnetic losses.



Experimental

Commercial elements:
Fe (53 µm, 99.9%),
Mn (75 µm, 99.9%),
Al (53-106 µm, 99.9%)

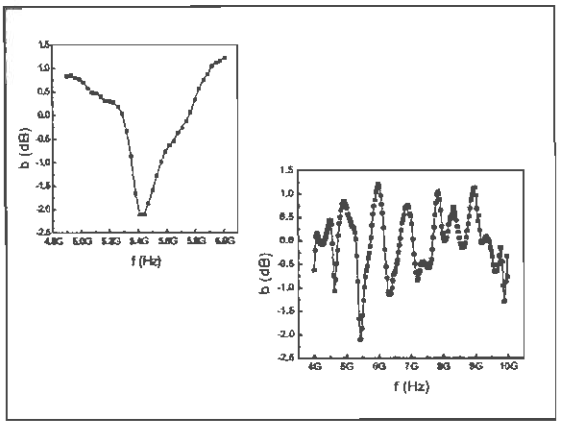
→ Mixing(Mechanical Alloying): 1 – 48 hrs

→ $Fe_{55}Mn_{10}Al_{35}$ Nano-crystalline and Amorphous alloys

Characterization:
1. The morphology and particle size were examined by FE-SEM;
2. X-ray Diffraction with the Cu-K_α radiation: MDI Jade 5 based on PDF2;
3. Extended X-ray absorption fine structure (EXAFS) with an energy of 2.5 GeV and a maximum current of 200 mA: software ATHENA;
4. Vibrating Sample Magnetometer (VSM) with magnetic field 2 kOe;
5. *Vector Network Analyser (VNA) result is still going on.*

Diagram shows preparation of FeMnAl nanocrystalline and amorphous

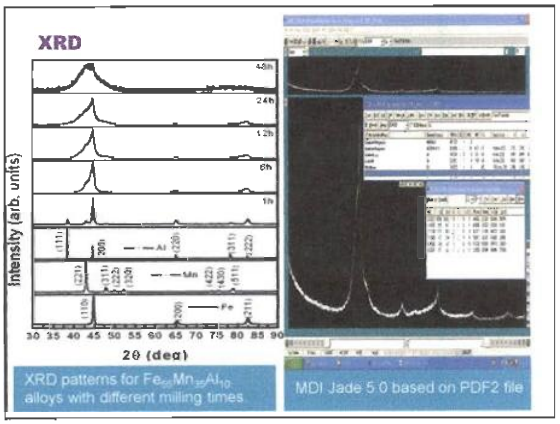
Results and Discussion



SEM

- The SEM image (x 100k) for $Fe_{55}Mn_{10}Al_{35}$-48h.
- SEM study revealed that the particles present in the samples had quite similar shapes for each sample, where very small particles were located on the surfaces of big particles.
- There are large particles or agglomerates with a shape tending to spherical.

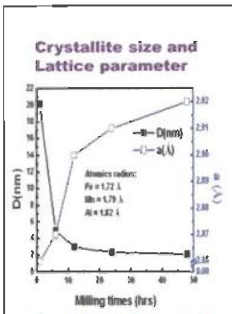
XRD

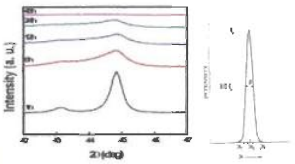


XRD patterns for $Fe_{55}Mn_{35}Al_{10}$ alloys with different milling times

MDI Jade 5.0 based on PDF2 file

Crystallite size and Lattice parameter





$D=(0.9\lambda)/(B\cos\theta_h)$ (scherrer eq.)

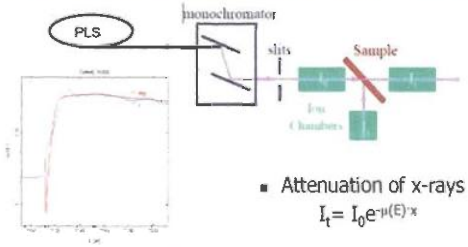
λ = X-ray wavelength (1.5406 Å)
B=full width at half maximum (FWHM)
θ_h=diffraction angle at the B peak based on (110)

$n\lambda = 2d_{hkl}\sin\theta$ and $d_{hkl} = a/(h^2 + k^2 + l^2)^{1/2}$ (Bragg's eq.)

n = integer, d_{hkl} = d spacing and a = lattice parameter

Extended X-ray Absorption Fine Structure (EXAFS):

refers to the oscillatory variation of the X-ray absorption as a function of photon energy beyond an absorption

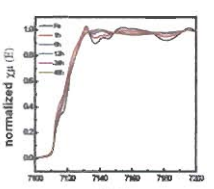


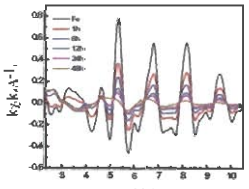
- Attenuation of x-rays
  $I_t = I_0 e^{-\mu(E)\cdot x}$
- Absorption coefficient
  $\mu(E) \propto I_f / I_0$

$$\chi(E) = \frac{\mu(E) - \mu_0(E)}{\mu_0(E)}$$

Energy to wave number

EXAFS spectra generally refer to the region 40-1000 eV above the absorption edge (in this case 7112 eV).





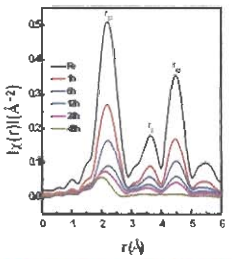
$$k = \sqrt{\frac{2m}{\hbar}(E - E_0)} \Rightarrow \chi(k) = \sum_j \frac{N_j S_i(k) F_j(k) e^{-2\sigma_j^2 k^2} e^{-2r_j/\lambda_j(k)} \sin(2kr_j + \phi_{ij}(k))}{kr_j^2}$$

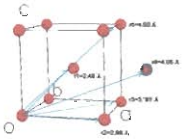
The reduction of the amplitude is related to the disorder of local structure, and the variation of the phase is related to the change of chemical order.

$$\chi(k) = \sum_j \frac{N_j S_i(k) F_j(k) e^{-2\sigma_j^2 k^2} e^{-2r_j/\lambda_j(k)} \sin(2kr_j + \phi_{ij}(k))}{kr_j^2}$$

- $F_j(k)$: the backscattering amplitude,
- σ_j : Debye-Waller factor,
- r_j : distance r_j away),
- $\phi_{ij}(k)$: the total phase shift experienced by the photoelectron,
- e^{-2r_j/λ_j}: due to inelastic losses in the scattering process,
- λ_j : the electron mean free path,
- $S_i(k)$: the amplitude reduction factor due to many-body effects such as shake up/off process at the central atom (denote by i).

Fourier Transform (FT)



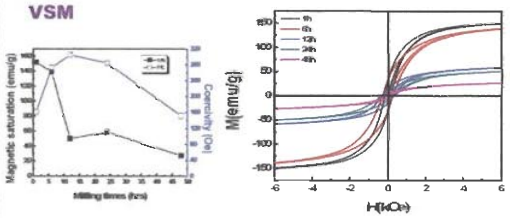


$$\rho_n(r) = \frac{1}{(2\pi)^{1/2}} \int_{k_{min}}^{k_{max}} w(k) k^n \times (k) e^{i2kr} dk$$

$$w(k) = \frac{1}{2}\left[1 - \cos 2\pi\left(\frac{k - k_{min}}{k_{max} - k_{min}}\right)\right]$$

The significant changes in the amplitude and the phase took place after 12 h which indicates that the alloying was dominant and new phases were formed at this period. The amount of the new phases increased as the processing time increased. At 24 h, the material became amorphous.

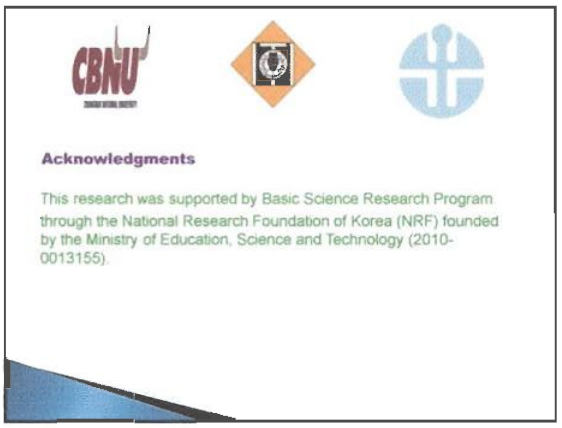
VSM



H_c is increased for the short time of milling could be attributed to particle size reduction, which converts them from a multi-domain state to a mono domain state. Nevertheless, when it is over milled, it tends to become highly disordered and its crystallite size is significantly reduced, losing part of its high magnetic anisotropy thus reducing Hc. (J. Sort et al., *Phys. Rev. B, vol.* 65, p. 174420, 2002.)

Conclusion

- The formations of $Fe_{85}Mn_{10}Al_{35}$ nano-crystalline and amorphous alloys were explicitly shown in the XRD patterns with shifted and broadened peaks.
- EXAFS spectra showed variations in the amplitude and the phase for the samples with milling time of 12 hrs and afterwards.
- The significant change in the structural phase confirmed that Al and Mn atoms were introduced to the Fe host lattice during the mechanical alloying process.
- In the amorphous state the atoms of long-range order were vanished.
- The $Fe_{85}Mn_{10}Al_{35}$ alloy is a good agreement with phase diagram of the ternary Fe-Mn-Al system by Chakrabarti as a ferromagnetic with the bcc structure.
- M_s was decreased due to the magnetic dilution caused by the incorporation of Al and Mn. Meanwhile, H_c decreased due to the development of single domains and the reduced particle size.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Shielding effectiveness study of Fe-Mn-Al Nanocrystalline and Amorphous Alloys

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Keywords: $Fe_{55}Mn_{10}Al_{35}$ nanocrystalline and amorphous alloys, Extended X-ray absorption fine structure spectroscopy (EXAFS) and Vector Network Analyser (VNA)

Abstract. In the last decade, applications of soft magnetic amorphous and nanocrystalline alloys are of increasing interest. Many properties of these materials are superior to those of the conventional alloys with the same chemical composition. The formations of $Fe_{55}Mn_{10}Al_{35}$ nanocrystalline and amorphous alloys which was made by using mechanical alloying (MA) technique with various times of 1 to 48 hrs were explicitly shown in the XRD patterns with shifted and broadened peaks. Also EXAFS spectra showed variations in the amplitude and the phase for the samples with milling time of 12 hrs and afterwards. The significant change in the structural phase confirmed that Al and Mn atoms were introduced to the Fe host lattice during the mechanical milling process. In the amorphous state the atoms of long-range order were disappeared. The $Fe_{55}Mn_{10}Al_{35}$ alloy is in a good agreement with phase diagram of the ternary Fe-Mn-Al system by Chakrabarti as a ferromagnetic with the bcc structure. In fact, magnetic saturation (*Ms*) was decreased due to the magnetic dilution caused by the incorporation of Al and Mn. Meanwhile, magnetic coercivity (*Hc*) was decreased due to the development of single domains and the reduced crystallite size. In this paper it will be reported also the shielding effectiveness of the Fe-Mn-Al Nanocrystalline and Amorphous Alloys.

THE INTERNATIONAL SEMINAR ON MAGNETIC MATERIALS 2013

III

"Magnetic Technology Innovation for Self-Development of Transportation and Energy Industries based on National Natural Resources"

Program Book

(Lamp. B1.7.6)

III

HARMONI ONE HOTEL , BATAM

24—25 October 2013

PT Magna Sardo

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PREFACE

Welcome to the International Seminar on Magnetic Materials 2013. It is a great pleasure for Center for Technology of Nuclear Industrial Material (PTBIN) - BATAN to be co-hosting this biennial event with Research Center for Physics (P2F) - LIPI and Magnet Consortium under the project of Ministry of Research and Technology, in the spirit of strengthening of cooperation and mutual growth to be the world class institution. For the first time, the International Seminar relating with Magnetic Materials is held in Batam Island, Indonesia. In order to increase the role of nuclear technology in the research and development of magnetic materials and magnetism to support the industry and energy in Indonesia, the Center for Technology of Nuclear Industrial Materials - BATAN in cooperation with the Research Center for Physics - LIPI and Magnet Consortium - Ministry of Research and Technology will hold "The International on Magnetic Materials 2013 (8th Magnetic Materials 2013). This activity will be held in Batam on 24 - 25 October 2013, which is filled with some activities including keynote speaker presentations, plenary parallel presentation delivered by the invited speakers from domestic and abroad, poster presentation, and also visiting to industry. This seminar aims to broadly disseminate the results of research and development in the field of magnetism and magnetic materials, as well as to encompass a conductive partnership between R & D institutions, industry, and universities throughout Indonesia. Several experts from industry, research and development and higher education in Indonesia and the region are expected to attend this seminar. Through this partnership it is expected to provide support and motivation to the perpetrators of R & D, industry and policy makers in an effort to increase the independence of the industry, particularly the electric car industry and energy for the welfare of the nation.

Our deepest gratitude to all of speakers, participants, and contributors who have given support so that this conference can be run well. Thank you to BP Batam Indonesia that has facilitated the International Seminar on Magnetic Materials 2013 can be held on the Batam islands. I would also like to thank all members of the organizing committee for all of their immense supports in making this conference a success. Allow us to wish all of you that this conference can a meaningful and rewarding. We wish you a pleasant and memorable stay in Batam. Finally, we hope to see you again at the next International Seminar on Magnetic Materials 2015.

Dr. Salim Mustofa, M.Eng

Chairman I of the International Seminar on Magnetic Materials 2013

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LIST OF PARTICIPANTS – ISMM 2013

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1	PTBIN	Abu Kholid Rivai	The Utilization of Magnetic Force Microscopy For Studying (La0.8Ba0.2)Fex(Mn,Ti)½(1-x)O3 Magnets
2	PTBIN	Adel Fisli	Synergetic Effect Adsorption, Photocatalytic and Magnetically Separable of Fe3O4/SiO2/TiO2 Composite For Removal Methylena Blue in Water
3	P2F	Agus Sukarto	The Development Of Multi-Type Magnetic Field Press For Magnetic Particle Orientation On The Manufacturing Of Permanent Ferrite Magnet
4	P2F	Ahmad Maulana Suhada	Effect of Mn-Ti Ions Dopant and Sintering Temperature on Barium Hexaferrite Magnetic Phase
5	UIN	Ambran Hartono	Effect of Mechanical Treatment Temperature on Electrical Conductivity of PVDF Film
6	PTBIN	Ari Handayani	Morphology and Magnetic Properties of Fe/Fe-Oxide Core/Shell Nanoparticle Prepared By High Energy Milling Process in Varied Medium
7	USU	Awan Maghfirah	Permanent Bonded Magnet PrFeB with Silicone Rubber
8	UI	Bambang Soegijono	Effect of field absorb thickness on absorbing properties of La0.8Ba0.2Fe0.3(Mn,Ti)0.35O3
9	USU	Bisman P.	Magnetic properties of Cu2+ Substituted BaFe(12-x)CuxO19(with x=0.1, 0.2, 0.3, ..., 4)
10	P2F	Candra Kurniawan	Corrosion Rate Effect of Ni-Strike Pretreatment on Nickel Plating Process for Bonded PrFeB Permanent Magnets
11	PTBIN	Didin S Winatapura	Effect of Calcium Substitution to Magnetic Properties of Barium Hexaferrite Synthesized with Co-Precipitation Method
12	UTS	Dwi Wahyu Nugroho	Synthesis and Characterization aFe2O3 from Natural Iron Ore Using Precipitation Method
13	UGM	Edi Suharyadi	Magnetic Nanostructures: Fabrication and Applications from Memory Devices to Biosensor
14	PTBIN	Eko Yudho P.	Design of Microfluidic-GMR Measurement System for Sensing Ferrofluid

15	PTBIN	Grace Tj. Sulungbudi	Preparation of Chitosan Coated Magnetic Nanoparticles for Biomedical Application
16	ITI	K. Tarigan	Shielding effectiveness study of Fe-Mn-Al Nanocrystalline and Amorphous Alloys
17	USU	Kerista Sebayang	Microstructure, Magnetic Properties and Microwave Absorption of BaFe(12-x)MnxO19 Soft Magnet
18	PPGN	Kurnia Trinopiawan	Indonesian Rare Earth and Its Extraction Technology
19	P2F	Lukman Faris	Magnetic Properties of Barium Hexaferrite by Nicolson Ross Weir (NWR) Algorithm Method
20	UI	M. Aziz Majidi	Effect of Mn and Ti addition on the phase and composition of Ba0.5Sr0.5O.6Fe2O3
21	UI	Mahendra Anggaravidya	The synthesis and characterization of composite rubber – lanthanum manganite modification have been performed.
22	PTBIN	Mardiyanto	*Magnetic Force Microscope (MFM) :* Atomic Force Microscope (AFM) for magnetic material research purposes
23	P2F	Maria Margaretha Suliyanti	Potential Candidate for Gigahertz range Electromagnetic wave absorbers of Carbon Sheets Based on Polymer
24	PTBIN	Mashadi	Synthesis and Characterization of Magnetic Properties Fe-C Nanocomposite
25	UI	Maykel Menawan	Microstructures, magnetic properties and microwave absorptioncharacteristics of Ti2+-Mn4+substituted Barium Hexaferrite
26	P2F	Muljadi	Effect of Backelite Composition and Milling Time to Density and Magnetic Properties on Preparation of Bonded NdFeB with Backelite as Binder
27	PPET	Nanang Sudrajat	Magnetic Properties of Ba1-xGdxFe12O19 (x=0,05; 0,10; 0,15) Synthesized by Autocombustion Sol-gel Process
28	UI	Novizal	Influence of Temperature on Structural and magnetic properties of (Ba(1-x)Sr(x)Fe12O19)-(Ba(1-x)Sr(1-x)TiO3) (where x = 0.3, 0.5, 0.7) composite prepared by milling.
29	PPET	Novrita Idayanti	Influence of pH on Magnetic Properties of BaFe12O19
30	PTBIN	Nurdin Effendi	The non-standard ferritic stainless steel coded by F1 had been made by foundry methods.

31	PTBIN	Patricius Purwanto	Identification and Characteristic of Electrical and Magnetic Properties of MWCNT-Fe.
32	P2F	Perdamean Sebayang	Preparation and Characterization of Bonded NdFeB Permanent Magnet
33	Unsri	Poedji Loekitowati Hariani	Kinetics of Adsorption Procion Red Dye by Activated Carbon-Fe3O4 Magnetic Composite
34	P2F	Priyo Sardjono	Magnetic and electric properties of La0.8Ba0.2TixMn(1-x)O3 system for Microwave Absorber Material (x = 0, 0.3, 0.5 and 0.7)
35	Unand	Ramli	Giant Magnetoresistance Effect in NiCoFe/Alq3/NiCoFe Thin Film
36	PTBIN	Salim Mustofa	AFM Studies of Diamond/Si (100) Thin Film After Irradiation of Fe and Ar Ion Associated with Magnetoresistance Properties
37	PTBIN	Setyo Purwanto	Structure Modification of CVD Diamond Film/SI(111) In Nano Scale By Post Implantation with Fe+B, Ni-Fe+B Ions and Argon Ion Sputtering in Relation to Their Giant Magnetoresistance Properties
38	UIN	Sitti Ahmiatri	The Microwave Absorption Properties of La0.67Ba0.33Mn0.98TM0.02O3(TM=Ti, Ni)
39	LAPAN	Sofian Rizal	Applied temperature using one wire DS18B20 very useful especially in room enough small where temperature enough influential like in micro payload satellite.
40	P2F	Suprapedi	Permittivity Determination of Barium Hexaferrite by Nicolson Ross Weir (NWR) Algorithm Method
41	USU	Syahrul Humaidi	Effect of Composition and Sintering Temperature on Magnetic Properties of Ba-Hexaferrite
42	Unand	Syukri Arief	A modified version of co-precipitation technique that uses of cellulose as a mild reducing agent was applied in the fabrication of magnetite (Fe3O4) nanoparticles.
43	UIN	Teddy Sebastian	Magnetic and Physical Properties of Barium Hexaferitte Permanent Magnet Doped by La Ions
44	UTS	Tito Prastyo Rahman	Synthesis and Application Manganese Ferrite Black Pigment (MnFe2O4) for High Temperature Resistance Paint
45	UAD	Toifur	Optimization of Coil Parameters as a Candidate of Temperature Sensor Device Based OaN Magnetic Susceptibility

46	P2F	Toto Sudiro	Fabrication and Characterization of Bounded Nd-Fe-B Magnet
47	PTBIN	Wisnu Ari Adi	The synthesis and characterization of the magnetic materials of La0.8Ba0.2FexMn(1-x)O3 system (x = 0 – 0.7) by mechanical alloying
48	UPH	Yohanes Edi Gunanto	Ferromagnetic in La0.73Ca0.27MnO3
49	PTBIN	Yosef Sarwanto	Preliminary Study of Silica Coating on Fe3O4 Nanoparticle Using Planetary Ball Mill
50	PTBIN	Yunasfi	Strusture and Magnetic Properties of Ni-C Nanocomposite for Sensor Material Application
51	PTBIN	Yunasfi	Silica Coated Magnetic Nanoparticles Synthesized Trough Chemical Reaction

Schedule of the International Seminar on Magnetic Materials 2013
Harmoni One Hotel, Batam Island, Indonesia, 24-25 October 2013

October 24, 2013 (Thursday)

Time	Program	
08:00 – 09:00	Registration	
09:00 – 09:30	**Opening Ceremony :** 1. Welcome Speeches from Organizing Committee 2. Welcome Speeches from Head of Indonesia Institute of Sciences (LIPI) 3. Welcome Speeches from Chairman of BP Batam 4. Opening Remarks from Head of National Nuclear Energy Agency (BATAN)	
09:30 – 09:45	Coffee Break	
09:45 – 09:55	**Keynote Speaker :** Consortium of Magnet Indonesia Dr. Ing. Priyo Sardjono	
	Invited Speaker (Pleno) :	**Chair:** Dr. Azwar Manaf, M.Met. **Co-chair:** Muljadi, M.Sc.
09:55 – 10:15	Batam Readiness in Implementing Renewable Energy **Dr. Ir. Tjahjo Prionggo,** BP Batam	
10:15 – 10:35	R&D Policy of Magnetic Materials in Indonesia **Dr. Mesdin S.,** Bappenas Indonesia	
10:35 – 10:55	New Paths toward Novel Room Temperature Half-metallic and Ferromagnetic Materials and Their Physical Characterizations **Dr. Andrivo Rusydi,** National Univ. of Singapore (NUS)	
10:55 – 11:15	Magnetic Application for Innovation Generator **Mr. Wahyu Utomo,** BOD PT Pindad Indonesia	
11:15 – 11:35	Business Propect of Magnet Materials **Mr. Chong** (Singapore), Consultant PT Sintertech	
11:35 – 11:55	Development of Magnetic Nanoparticles Embedded in Polymer Membrane for MEMS Actuators **Assoc. Prof. Dr. Jumril Yunas,** University Kebangsaan Malaysia	

11:55 – 12:15 12:15 – 12:45	The Role of Generator with Permanent Magnet Materials in Renewable Energy Power Plant Mr. Fazil E Alfitri, CEO Medco Power Indonesia Discussion (Talk show)	
12:45 – 13:30	**ISOMA, Technology and Products Exhibition**	
13:30 – 14:50	Parallel Session (Oral Presentation) : Group A	**Chair:** Dr. Suprapedi **Co-chair:** Candra Kurniawan, SSi.
13:30 – 14:50	Parallel Session (Oral Presentation) : Group B	**Chair:** Prof.Dr. Masno Ginting **Co-chair:** Ayu Yuspitasari, SSi.
14:50 – 15.50	Poster Presentation	**Chair :** Prof. Drs. Perdamean, MSc.
15:50 – 16:20	**Closing :** 1. Recommendation from Organizing Committee Prof. Dr. Ridwan 2. Closing remarks by Head of BATAN	**Chair:** Drs. Gunawan, M.Sc.
16:20 – 17:00	Coffee Break	

October 25, 2013 (Friday)

Time	Program	
08:00 – 09:00	Gathering at the Lobby of Harmony One Hotel	Guided by: Prof. Drs. Perdamean S., M.Sc. Edi Triastuti, M.Eng.
09:30 – 10:30	Visiting to PT. Sanyo Precision Batam	
10:45 – 11:45	Visiting to PT. Schneider Electric Batam	
11:45 – End	Free time (Back to Harmoni One Hotel - Batam)	

Schedule of Parallel Session

No.	Affiliation	Author	Time	Room	Presentation
1	PTBIN	Abu Kholid Rivai	13.30-13.35	ROOM I Mod. : Dr. Suprapedi Ass. : Candra K., S.Si.	Oral
2	UPH	Yohanes Edi Gunanto	13.35-13.40		Oral
3	UIN	Ambran Hartono	13.40-13.45		Oral
4	USU	Awan Maghfirah	13.45-13.50		Oral
5	P2F	Candra Kurniawan	13.50-13.55		Oral
	Discussion IA		13.55-14.10		
6	UTS	Dwi Wahyu Nugroho	14.10-14.15		Oral
7	UGM	Edi Suharyadi	14.15-14.20		Oral
8	ITI	Kontan Tarigan	14.20-14.25		Oral
9	PPGN	Kurnia Trinopiawan	14.25-14.30		Oral
10	UI	Maykel Menawan	14.30-14.35		Oral
	Discussion IB		14.35-14.50		
11	UI	Novizal	13.30-13.35	ROOM II Mod. : Prof. Dr. Masno Ginting Ass. : Ayu Yuswitasari, S.Si.	Oral
12	PPET	Novrita	13.35-13.40		Oral
13	PTBIN	Nurdin Effendi	13.40-13.45		Oral
14	Unsri	Poedji Loekitowati H.	13.45-13.50		Oral
15	Unand	Ramli	13.50-13.55		Oral
	Discussion IIA		13.55-14.10		
16	UIN	Sitti Ahmriati	14.10-14.15		Oral
17	LAPAN	Sofian Rizal	14.15-14.20		Oral
18	Unand	Syukri Arief	14.20-14.25		Oral
19	UAD	Toifur	14.25-14.30		Oral
20	P2F	Agus Sukarto	14.30-14.35		Oral
	Discussion IIB		14.35-14.50		

Poster Session

No.	Affiliation	Author	Code	Presentation
1	PTBIN	Adel Fisli	P1	Poster
2	P2F	Ahmad Maulana Suhada	P2	Poster
3	PTBIN	Ari Handayani	P3	Poster
4	UI	Bambang Soegijono	P4	Poster
5	USU	Bisman Perangin-Angin	P5	Poster
6	PTBIN	Didin S Winatapura	P6	Poster
7	PTBIN	Eko Yudho Pramono	P7	Poster
8	PTBIN	Grace Tj Sulungbudi	P8	Poster
9	USU	Kerista Sebayang	P9	Poster
10	P2F	Lukman Faris	P10	Poster
11	UI	Mahendra Anggaravidya	P11	Poster
12	PTBIN	Mardiyanto	P12	Poster
13	P2F	Maria Margaretha Suliyanti	P13	Poster
14	PTBIN	Mashadi	P14	Poster
15	UI	Muhammad Aziz Majidi	P15	Poster
16	P2F	Muljadi	P16	Poster
17	PPET	Nanang Sudrajat	P17	Poster
18	PTBIN	Patricius Purwanto	P18	Poster
19	P2F	Perdamean Sebayang	P19	Poster
20	P2F	Priyo Sardjono	P20	Poster
21	PTBIN	Salim Mustofa	P21	Poster
22	PTBIN	Setyo Purwanto	P22	Poster
23	P2F	Suprapedi	P23	Poster
24	USU	Syahrul Humaidi	P24	Poster
25	UIN	Teddy Sebastian	P25	Poster
26	UTS	Tito Prastyo Rahman	P26	Poster
27	P2F	Toto Sudiro	P27	Poster
28	PTBIN	Wisnu Ari Adi	P28	Poster
29	PTBIN	Yosef Sarwanto	P29	Poster
30	PTBIN	Yunasfi	P30 & P31	Poster