

## -----BIO-DATA-----

### **Dr. SATNAM SINGH**

B.Sc, M.Sc, Ph.D (Physics)

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### **Professional Experience**

<b>Duration</b>	<b>Position</b>	<b>Affiliation</b>
19August2016 - to- Continue.	Assistant Professor	Maharaja Ranjit Singh Punjab Technical University, Punjab
17April2014 -to- 17August2016.	Assistant Professor	Baba Farid College, Bathinda, Punjab
08 April 2011 -to- 07 April 2014	CSIR-Senior Research Fellow (CSIR-S.R.F)	CSIR-National Metallurgical Laboratory, Jamshedpur
19 July 2007 -to- 07 April 2011	Project Assistant (P.A)	CSIR-National Metallurgical Laboratory, Jamshedpur

### **Publications/ Patents / Presentations:**

- Research Projects : 02
- Publications in International Journals : 10
- Publications in National Journals (Indian) : 02
- Presentations in Seminar /Conference : 04
- Workshop and training programs : 02
- Patent : 01

### **PhD Details:**

***Title of thesis*** : Studies on Magnetic Field Induced Strain and Phase Transformation in Rapidly Solidified NiMnGa and CoNiAl Ferromagnetic Shape Memory Alloys.

***PhD Supervisors*** : 1) Dr. A.K. Panda (Senior Scientist, NML Jamshedpur)

2) Prof. N.B. Manik (Associate Professor, Jadavpur University, Kolkata)

**University Name** : Jadavpur University, Kolkata (India).  
**Registration Date** : 03/08/09  
**Thesis defended** : 09/04/2014  
**Award Date** : 28/05/2014  
**PhD Course Work** : Indian Association for Cultivation of Science  
**Subjects** : 1) Advanced Solid State Physics  
2) Review and Research Methodology

### **Academic Qualifications**

Degree	University / college/ board	Year of Passing	% of Marks	Division	Subjects
Ph.D	Jadavpur, University Kolkata	May 2014	-	-	Physics
MSc.	MDU, Rohtak	February 2005	62.62	1 <sup>st</sup>	Physics
BSc.	MDU, Rohtak	June 2003	65.17	1 <sup>st</sup>	Physics, Statistics and Maths
10+2	BSEH	June 1999	55	2 <sup>nd</sup>	Physics, Chemistry, Maths, Hindi and Eng.
10 <sup>th</sup>	BSEH	June 1997	57	2 <sup>nd</sup>	Science, Maths, Hindi, English, SST.

### **Research Projects Involvement:**

- Studies on Effect of Sn as dopant in FeMnGe and CoMnGe based magnetocaloric materials. Sponsored by: *Department of Science and Technology (C.V: 12.55 lakhs)*. Duration: *Recently approved*. Status: ongoing.
- Development of NiMnGa based Ferromagnetic Shape Memory Alloys by melt spinning route. Sponsored by: *In-House Project Support Group, CSIR-NML*, Duration: 01-04-2011 to 31-03-1013, Status: Completed.

### **Awards Honours and Recognitions:**

- ❖ CSIR- Senior Research Fellowship for the year 2011 to 2013 via CSIR file No: 31/10/46/2011/EMR-I.
- ❖ National **Level Exams JEST-2008 Qualified** with 90.17 percentile and 432 all India rank.
- ❖ Second prize in poster presentation for paper entitled “*Influence of Rapid Quenching and Heat treatment on Melt Spun NiMnGa based Ferromagnetic Shape Memory Alloys*” by **Satnam Singh**, R.K. Roy, M. Ghosh, A. Mitra and A.K. Panda at the 50<sup>th</sup> NMD and 66<sup>th</sup> Annual Technical Meeting of Indian Institute of Metals held at Jamshedpur on 16-19 Nov. 2012.
- ❖ First prize in Metallographic contest for paper entitled “*Effect of Al incorporation on the martensite transformation in Ni<sub>55</sub>Mn<sub>22</sub>Ga<sub>23</sub> (At%) Ferromagnetic Shape Memory Alloy*” by **Satnam Singh**, R.K.Roy, M.Ghosh, A. Mitra and A.K. Panda at 49<sup>th</sup> NMD and 65 Annual Technical Meeting of Indian Institute of Metals held at Hyderabad on 14-16Nov, 2011.
- ❖ First prize in Metallographic contest for paper Magnetic and Structural Properties of Rapidly Solidified Ni<sub>77-x</sub>Mn<sub>x</sub>Ga<sub>23</sub> (X= 22 to 29) Ferromagnetic Shape Memory Alloys” by **Satnam Singh**, RK Roy, M Ghosh, A Mitra and AK Panda at 48<sup>th</sup> NMD and 64<sup>th</sup> Annual Technical Meeting of Indian Institute of Metals held at IISc Bangalore, 14-16Nov, 2010.

### **Tanning Programs/ Workshops Attended:**

1. Participated in training program organized by UGC-DAE consortium for Scientific Research, Mumbai Centre and Solid State Physics division, BARC, entitled “*School on Neutrons as Probes of Condensed Matter NPCM-XIV*” held at Bhabha Atomic Research Centre, Mumbai India during 5-10 October 2009.

### **Patents:**

An Indian Patent (*CSIR application Ref. No. 0094NF2013*) entitled "A device for the measurement of magnetostriction of ferromagnetic materials", by A.K.Panda, **Satnam Singh**, R.K.Roy and A.Mitra is filed since 2013.

### **Areas of Research Interest:**

- Ferromagnetic Shape Memory Alloys
- Magneto-caloric Materials
- Spintronic materials
- Nano-structured and advanced magnetic materials
- Amorphous Alloys

### **Areas of Teaching Interest:**

- Condensed Matter Physics
- Classical Mechanics
- Electrodynamics
- Thermo-dynamics
- Statistical Mechanics

### **Experience:**

#### **Research Experience:**

*(i) Nano-Structured and advanced materials:* Also worked in the field of bilayered ribbons with layer of FeNbSiB and CoSiB alloys, Brazing material (CuMnNi) prepared by melt spinning technique, soft magnetic materials (like FeSiB, CoSiB etc.), Materials revealed Giant Magneto Impedance properties (CoFeNbSiB), Magneto-caloric materials (NiMnGa and NiMnGaAl).

*(ii) Material characterisations:* Expertise in handling and data analysis from the instruments: Vibrating Sample Magnetometer (VSM), Magnetic Hysteresis tracer, Differential Scanning Calorimeter (DSC), Thermal variation of Electrical Resistivity (TER), optical microscopy, x-ray diffractometer (XRD). Also know sample preparation and data analysis for Transmission Electron Microscope (TEM).

*(iii) Developed Device:* A device have been developed for direct measurement of Magnetic Field Induced Strain / magneto-striction of Ferromagnetic Shape Memory Alloys (FSMA's) / magneto-strictive materials in the shape of ribbons and wires.

*(iv) Software's and Platforms:* Sound knowledge of Microsoft Office, PDF, LateX, EndNote, Adobe PhotoShop, LabView MatLab, JCPCS-PDF, MAUD, FullProof etc.

(v) **Ph.D Work:** The Ph.D. work was focused on the *Ferromagnetic Shape Memory Alloys (FSMAs)*. The FSMAs are well known for their large magnetic field induced strain; finally find their applications as actuator material. These materials have been usually prepared by expansive crystal growth techniques. Moreover the size of the final material is restricted by crystal size and has the possibility of attaining crystal defect. Therefore, alloy NiMnGa and CoNiAl have been prepared in series through Rapid Solidification route by Melt Spinning technique. The Melt Spinning technique has tendency to alter mechanical, magnetic, transformation and structural properties. In this view, the improvements in Magnetic Field Induced Strain (MFIS) and phase transformation have been targeted in the prepared alloys.

Initially, alloys with nominal composition  $\text{Ni}_{77-x}\text{Mn}_x\text{Ga}_{23}$  ( $X= 22, 23, 24, 25, 27, 29$ ) (at %) was prepared. The alloys revealed increase in martensitic transformation temperature (MT) reducing Mn concentration. The TEM investigations revealed systematic change in morphology of ribbons from austenite to martensite by lowering Mn concentration. In this investigation alloy with  $X=22$  showed high MFIS which was further improved through heat treatment. Thereafter, effects of Al addition in place of Ga has been studied for  $X=22$  ribbon. A non-monotonic change in MT has been observed in a series of  $\text{Ni}_{55}\text{Mn}_{22}\text{Ga}_{23-y}\text{Al}_y$  ( $Y=0, 0.5, 1, 2, 3, 5$ ) (at %) annealed ribbons. The low Al containing alloys showed a combination of martensitic and austenitic phases which diminished with the substitution of Ga by Al. The optimum content of martensite and austenite phases in alloy with  $Y=1$  at%, improved micro-structure and led to the enhancement of MFIS.

Investigations have also been carried out on  $\text{Co}_{64-z}\text{Ni}_{36}\text{Al}_z$  (at%,  $Z=23, 24, 26$  and  $28$ ) melt spun ribbons. All the alloys revealed  $\beta$ - and  $\gamma$ -phase structures, their volume fraction varied with Al content. The  $\gamma$ -rich (low Al) alloys showed magnetically soft phase whereas the Co depleted high Al alloys displayed reduced magnetization and Curie temperatures. The low Al alloy ( $X=23$ ) showed high magneto-strain, which decreases drastically with increasing Al. These features have been correlated to low dislocation density and feebly strain twined structure.

The melt spun ribbons showed superior properties as compared with their bulk material prepared by conventional melting casting route. The micro-structures of bulk alloys showed features of high dislocation and high lattice strain although a single martensite phase. These features are less likely to show with MFIS. Whereas, ribbons showed a small fraction of austenite phase within martensite fascinated twin boundary motion an henceforth revealed high magneto-strain values.

## **Publications in International Journals**

1. Sushmita Dey, **Satnam Singh**, R. K. Roy, M. Ghosh, A. Mitra, A. K. Panda, "Influence of Mn incorporation for Ni on the magnetocaloric properties of rapidly solidified off-stoichiometric NiMnGa ribbons" *Journal of Magnetism and Magnetic Materials*, 397 (2016) 342-346.
2. A. K. Panda, Sushmita Dey, R. K. Roy, **Satnam Singh**, A. Mitra, "Influence of phase transformation on interfacial activity and bend sensitivity of rapidly quenched Fe<sub>77.5</sub>Si<sub>7.5</sub>B<sub>15</sub>/Co<sub>72.5</sub>Si<sub>12.5</sub>B<sub>15</sub> bilayered magnetostrictive ribbons" *Journal of Magnetism and Magnetic Materials*, 378 (2015) 440-446, ISSN: 03048853 (J. Imp. fact. 2.002).
3. **Satnam Singh**, R.K. Roy, B. Mahato, M. Ghosh, A. Mitra and A.K. Panda, "Effect of Al incorporation for Co on the Gamma-Beta Phase boundary of Rapidly Solidified CoNiAl Ferromagnetic Shape Memory alloys". *Journal of Magnetism and Magnetic Materials*, 368 (2014) 378-383, ISSN: 03048853 (J. Imp. fact. 2.002).
4. **Satnam Singh**, R K Roy, M Ghosh, A Mitra, A.K.Panda, "Martensitic Transformation and Magneto-strain in Melt Spun NiMnGaAl Ferromagnetic Shape Memory Alloys", *Intermetallics*, 43 (2013) 147-151, ISSN : 09669795 (J. Imp. fact. 2.119).
5. **Satnam Singh**, R. K. Roy, M. Ghosh, N. B. Manik, A. Mitra, and A. K. Panda, "Modification in Martensite Morphology and Magneto-Strain through Rapid Solidification and Heat Treatment of NiMnGaAl Alloy", *Journal of Magnetism and Magnetic Materials*, 343 (2013), 169-172, ISSN : 034-8853 (J. Imp. fact. 2.002).
6. A.K. Panda, R.K Roy, Sushmita Dey, **Satnam Singh**, A.Mitra, "Functional gradation through preferential crystallisation and interfacial activity in rapidly quenched Fe/Co-based bilayered ribbons for bend sensors", *Journal of Applied physics* 114 (2013) 023909, ISSN : 0021-8979 (J. Imp. fact. 2.210) .
7. **Satnam Singh**, R. K. Roy, M. Ghosh, A. Mitra, and A. K. Panda, "Heat Treatment Induced Martensitic Accommodation and Adaptive Anisotropy in Melt Spun Ni<sub>55</sub>Mn<sub>22</sub>Ga<sub>23</sub> (At. %) Ribbons", *Journal of Applied Physics*, 112 (2012), 103512, ISSN : 0021-8979 (J. Imp. fact. 2.210).
8. R. K. Roy, **S. Singh**, M. K. Gunjan, A. K. Panda, and A. Mitra, "Joining of 304SS and Pure Copper by Rapidly Solidified Cu-Based Braze Alloy", *Fusion Engineering and Design*, 86 (2011), 452-455, ISSN : 0920-3796 (J. Imp. fact. 1.146) .
9. A.K. Panda, **Satnam Singh**, R. K. Roy, M. Ghosh, and A. Mitra, "Effect of Mn Incorporation for Ni on the Properties of Melt Spun Off-Stoichiometric Compositions of NiMnGa Alloys", *Journal of Magnetism and Magnetic Materials*, 323 (2011), 1161-69, ISSN : 034-8853 (J. Imp. fact. 2.002) .

10. A.K. Panda, **Satnam Singh**, S. K. Das, A. Mitra, M. Koblishka, Brice Jamieson, and Saibal Roy, "Effect of Magnetizing Field on the Martensitic Transformations in a Melt Spun NiMnGa Alloy", *Journal of Physics D: Applied Physics*, 42 (2009), 245004, ISSN : 1361-1267 (J. Imp. fact. 2.521).

### **Publications in National Journals**

1. **Satnam Singh**, A.Mitra, A.K.Panda "Magnetic and Structural Evolution in Ni-rich off-stoichiometric NiMnGa Melt Spun Ribbons" *J. Met & Mat. Sc*, 51,3(2009)197, ISSN : 0947-126).
2. A.K. Panda, **Satnam Singh**, Rajat Kumar Roy, Mainak Ghaosh and Amitava Mitra, Ferromagnetic Shape Memory Alloys (FSMAs) for Magneto-Mechanical Applications, *Journal of Science and Culture* 78(11-12) (2012) 577-579.

### **Presentation in International Seminar /Conference:**

1. **Satnam Singh**, A.Mitra, M.Ghosh and A.K.Panda "Ferromagnetic shape memory Transitions in NiMnGa based melt spun ribbons", *International conference on Magnetic materials and their applications for 21<sup>st</sup> century [MMA-21]*, Oct 21- 23, 2008, NPL, New Delhi

### **Presentations in National Seminar /Conference**

1. **Satnam Singh**, M.Ghosh, RK Roy, A Mitra and AK Panda, "Effect Influence of Rapid Quenching and Heat treatment on Melt Spun NiMnGa based Ferromagnetic Shape Memory Alloys" 50<sup>th</sup> NMD and 66<sup>th</sup> ATM, *Indian Institute of Metals Jamshedpur-chapter*, 16-19 Nov. 2012.
2. **Satnam Singh**, RK Roy, M.Ghosh, A Mitra and AK Panda, "Effect of Al incorporation on the martensite transformation temperature in Ni<sub>155</sub>Mn<sub>22</sub>Ga<sub>23</sub> ferromagnetic shape memory alloy" 49<sup>th</sup> NMD 65<sup>th</sup> ATM, *Indian Institute of Metals Hyderabad-chapter*, 14-16Nov, 2011.
3. **Satnam Singh**, A.K. Panda, A Mitra, "Development of NiMnGa based Ferromagnetic Shape Memory Alloy by Melt spinning Technique" *National symposium for research scholars, IIT Bombay*, May 17-18, 2008.

**Personal Details:**

Name : Satnam Singh  
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Languages Known: Hindi, English, and Punjabi.

**References:**

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I do hereby declare that the information provided above is true to the best of my knowledge.

Date :

Place :

(Dr. SATNAM SINGH)