Dr. Pradip Das

CURRICULUM VITAE

Postdoctoral Research Experience (2009, February onwards):

Project: Topological Insulator and Superconducting Material $Cu_xBi_2Se_3$(2010, January to Jul, 2012)
Institute of Materials Science, University of Tsukuba, Tsukuba, Japan

Project: Vortex state studies in new iron base superconductors (2009, February to 2009, December)
Dept. of Condensed Matter Physics & Materials Sciences,
Tata Institute of Fundamental Research, Mumbai, India

Ph. D. (2003 - 2009):

Thesis title: "Vortex State Studies in YNi_2B_2C and Elemental Niobium''
Department of Physics,
Indian Institute of Technology Bombay, India

Peer reviewed publications

Papers in refereed journals

1. Peak effect phenomena, surface superconductivity and positive field cooled magnetization in a spherical single crystal of niobium, **Pradip Das,** C.V. Tomy, S.S. Banerjee, H. Takeya, S. Ramakrishnan and A.K.Grover Phys. Rev. B. **78**, 214504 (2008). I. F 3.7 (Citation 4)

Appeared as ***focus new item in Nature India section of Nature Magazine*** *http://www.nature.com/nindia/2008/081228/full/nindia.2008.342.html*

2. Spin compensation in $YbSr_2RuO_6$ Ravi P. Singh, **Pradip Das,** C.V. Tomy AIP Proceedings, **1003**, 151 (2008)

3. Growth of textured nanocrystalline cobalt ferrite thin films by pulsed laser deposition L. Aditya, A. Srivastava, S. K. Sahoo, **P. Das,** C. Mukherjee, Abha Misra, V.R. Reddy, R. S. Shinde, Ajay Gupta, Shiva Prasad, I. Samajdar, R. V. Nandedkar, and N. Venkataramani, J. Nanosci. Nanotechnol. **8**, 4135 (2008). I. F 2

4. Anisotropy in the vortex phase diagram and the pinning force density in the basal plane of YNi_2B_2C, **Pradip Das,** C.V. Tomy, H. Takeya, S. Ramakrishnan and A.K. Grover Physica C **469**, 151 (2009). I. F 1.4

5. Themo-magnetic history effects in the vortex state of YNi_2B_2C superconductor, **Pradip Das,** C.V. Tomy, H. Takeya, S. Ramakrishnan and A.K. Grover J. Phys.: Conf. Ser. **150**, 052042 (2009).

6. Peak effect phenomena, surface superconductivity and paramagnetic Meissner effect in a spherical single crystal of niobium **Pradip Das,** C.V. Tomy, H. Takeya, S. Ramakrishnan and A.K. Grover J. Phys.: Conf. Ser. **150**, 052041 (2009).

7. Spin-triplet vortex state in the topological superconductor $Cu_xBi_2Se_3$ **Pradip Das,** Yusuke Suzuki, Masashi Tachiki, and Kazuo Kadowaki Phys. Rev. B. Rapid Communication **83**, 220513(R) (2011). ***Cited in Physics spotlight exceptional research by American Physical Society*** (http://physics.aps.org/synopsis-for/10.1103/PhysRevB.83.220513) (Citation 5) I. F 3.7

8. Pairing Symmetry and Magnetic Relaxation in Topological Superconductor $Cu_xBi_2Se_3$, **Pradip Das,** Yusuke Suzuki, Masashi Tachiki and Kazuo Kadowaki, accepted in J. Phys.: Conf. Ser.

9. Magnetization hysteresis and time decay measurements in $FeSe_{0.50}Te_{0.50}$: Evidence for fluctuation in mean free path induced, **P. Das**, Ajay D. Thakur, Anil K. Yadav, C. V. Tomy, M.R. Lees, G. Balakrishnan, S. Ramakrishnan, A. K. Grover, Phys. Rev. B. 84, 214526 (2011). (Citation 2) I. F 3.7

10. Role of Cu-doping in topological insulator Bi2Se3 studied by angle-resolved photoemission spectroscopy, Y. Tanaka, K. Nakayama, S. Souma, T. Sato, N. Xu, P. Zhang, H. Ding, Y. Suzuki, **P. Das**, Kazuo Kadowaki, and T. Takahashi, *Physical Review B* 85, 125111 (2012). (Citation 0) I. F 3.7

11. A detail study of the structural and physical properties of tri-functional Ni_{core}-Au_{shell} nano-chain engineered by DNA, Bipul Das, Debasish Sarkar, **Pradip Das**, Madhuri Mandal, communicated to J. Nanosci. Nanotechnol.

12. Magnetostatic interaction in two dimensional arrays of Cobalt nanowires, Bipul Das, K. Mandal, Pintu Sen, Ashis Bakshi, **Pradip Das**, Physica B, **407**, 3767–3773 (2012). I. F 0 (Citation 0)

Conference Proceeding

1. Observation of surface superconductivity and paramagnetic Meissner effect in a spherical single crystal of Nb Pradip Das, C.V. Tomy, H. Takeya, S. Ramakrishnan and A.K. Grover Solid State Physics (India) 53, 917 (2008)

2. Dynamical response of Flux line lattice: a ramp rate dependence magnetic isotherm study in single crystal YNi_2B_2C Pradip Das, C.V. Tomy, H. Takeya, S. Ramakrishnan and A.K. Grover Solid State Physics (India) 52, 817 (2007).

3. Magnetization Reversal in $YbSr_2RuO_6$ Ravi P. Singh, Pradip Das, C.V. Tomy Solid State Physics (India) 52, 1037 (2007).

4. Study of Pulsed Laser Deposition of Nanocrystaline $GaFeO_3$ thin film on single crystal YSZ (100) substrate as a function of temperature Pradip Das, Ravi P. Singh, Devang A. Joshi, C.V. Tomy, D. S. Misra Proceedings of the Advance Nano Materials, p. 299 (2007).

5. Synthesis of High Purity Multi walled carbon nanotube using ferrocene as catalyst in thermal chemical vapor deposition Pawan K. Tyagi, Abha Misra, Padmnabh Rai, Dipti Ranjan Mahapatro, Pradip Das, E. Titus, D.S. Misra, Jay Ghatak, P.V. Satyam Proceedings of the Advance Nano Materials p. 64 (2007).

6. Magnetic Properties of RNi_3FeGa compound (R = Y, La and Gd) Devang A. Joshi, Ravi P. Singh, Pradip Das, C.V. Tomy and S. K. Malik Solid State Physics (India) 51, 921 (2006).

7. Single crystalline nickel nanorods encapsulated inside carbon nanotubes Pawan K. Tyagi, Abha Misra, Manoj K. Singh, Pradip Das, D.S. Misra, Jay Ghatak, P.V. Satyam Solid State Physics (India) 49, 201 (2004).

8. Pradip Das, "Anisotropy Study by Torque Measurements and the Magnetic Relaxation Measurements in a Single Crystal of the Superconductor FeSe0.5Te0.5", presented as an poster presentation at the "7th International Symposium on Intrinsic Josephson Effects and Plasma Oscillations in High-Tc Superconductors", April 29th – May 2nd, Hirosaki University, Aomori, Japan.

9. A. Nozawa, T. Goya, H. Yamaguchi, Y. Jono, Y. Suzuki, P. Das, S. Hashimoto, T. Yamamoto, T. Kashiwagi and K. Kadowaki, "Synthesis and Study of FeP Single Crystals", presented s a poster presentation at the "4th AEARU Advanced Materials Workshop on Artificial and Self-Organized Nanostructure Sciences and Nano-Technologies for the Sustainable World", held in August 29th - September 3rd, 2010, in University of Tsukuba, Tsukuba, Japan

10. Y. Suzuki, P. Das, S. Hashimoto, T. Goya, Y. Jono, T. Yamamoto, H. Yamaguchi, A. Nozawa, T. Kashiwagi and K. kadowaki, "Single Crystal Growth of Topological Insulator CuxBi2Se3", presented s a poster presentation at the "4th AEARU Advanced Materials Workshop on Artificial and Self-Organized Nanostructure Sciences and Nano-Technologies for the Sustainable World", held in August 29th - September 3rd, 2010, in University of Tsukuba, Tsukuba, Japan

11. Y. Jono, S. V. Chong, T. Goya, H. Yamaguchi, P. das, T. Yamamoto, S. Hashimoto, Y. Suzuki, A, Nozawa, T. Kashiwagi, R. Yoshizaki and K. Kadowaki, "Synthesis and Physical Properties of BaFe2(As1-xPx)2 Single Crystals", presented s a poster presentation at the "4th AEARU Advanced Materials Workshop on Artificial and Self-Organized Nanostructure Sciences and Nano-Technologies for the Sustainable World", held in August 29th - September 3rd, 2010, in University of Tsukuba, Tsukuba, Japan.

12. H. Yamaguchi, T. Goya, Y. Jono, P. Das and K. Kadowaki, "Single Crystal Growth of Iron Based Superconductors by Vertical Bridgeman Method", presented s a poster presentation at the "4th AEARU Advanced Materials Workshop on Artificial and Self-Organized Nanostructure Sciences and Nano-Technologies for the Sustainable World", held in August 29th - September 3rd, 2010, in University of Tsukuba, Tsukuba, Japan.

13. P. Das, Y. Suzuki, S. Hashimoto, T. Goya, T. Yamamoto and K. kadowaki, "Topological Insulator CuxBi2Se3 and CaxBi2-xSe3", presented s a poster presentation at the "4th AEARU Advanced Materials Workshop on Artificial and Self-Organized Nanostructure Sciences and Nano-Technologies for the Sustainable World", held in August 29th - September 3rd, 2010, in University of Tsukuba, Tsukuba, Japan.

14. Touhei Jono, Tomoki Goya, Hisato Yamaguchi, Pradip Das, Shinya Hashimoto, Yusuke Suzuki, Akihiko Nozawa and Kazuo Kadowaki, “Synthesis and Physical Properties of 122 System of Iron-Based Superconductors”, presented at the “3rd International Symposium on Interdisciplinary Materials Science (ISIMS-2011)” held at Tsukuba International Congress Center (EPOCHAL), Tsukuba, Ibaraki, Japan, March 9-11, 2011.

15. Akihiko Nozawa, Tomoki Goya, HHisato Yamaguchi, Yohei Jono, Yusuke Suzuki, Pradis Das, Shinya Hashimoto, Takashi Yamamoto, Takanari Kashiwagi, Ryozo Yoshizaki and Kazuo Kadowaki, “Synthesis and Characterization of Prototype iron Based Superconductors”, presented at the “3rd International Symposium on Interdisciplinary Materials Science (ISIMS-2011)” held at Tsukuba International Congress Center (EPOCHAL), Tsukuba, Ibaraki, Japan, March 9-11, 2011.

16. Y. Suzuki, P. Das, H. Yamaguchi, T. Goya, Y. Jono, A. Nozawa, S. Hashimoto, T. Yamamoto, R. Yoshizaki, T. Kashiwagi and K. Kadowaki, “Single Crystal Growth and Physical Properties of Topological Insulator Bi2Se3”, presented at the “3rd International Symposium on Interdisciplinary Materials Science (ISIMS-2011)” held at Tsukuba International Congress Center (EPOCHAL), Tsukuba, Ibaraki, Japan, March 9-11, 2011.

17. Pradip Das, Y, Suzuki, M. Tachiki and K. Kadowaki, “Magnetization Studies in a Topological Insulator CuxBi2Se3 Single Crystal”, presented at the “3rd International Symposium on Interdisciplinary Materials Science (ISIMS-2011)” held at Tsukuba International Congress Center (EPOCHAL), Tsukuba, Ibaraki, Japan, March 9-11, 2011.

18. Pradip Das, S. Hashimoto, T. Goya, Y. Suzuki, T. Yamamoto, K. Kadowaki, "Topological Insulator CuxBi2Se3 and CaBi2-xSe3", 2010 Fall Meeting of the Physical Society of Japan (Osaka Prefecture 中百舌鳥held at the campus), September 23, 2010, 8 iron-arsenic superconductor region (23pWH-8), the third volume, Volume 65 Number 2 Physical Society of Japan Abstracts pp502.

Research Details:

The newly discovered topological insulators are materials with a bulk-insulating gap, exhibiting quantum-Hall-like behavior in the absence of a magnetic field. We studied the Cu intercalated Bi_2Se_3 and found differences in the behavior of vortices from what is found in usual type-II superconductors. We conclude that observations are consistent with odd-parity pairing and that the paired electrons form a spin-triplet state driven by strong spin-orbit interactions in the material. We published our research work in an article as a Rapid Communication in *Physical Review B*, and was *cited in Physics spotlight exceptional research by American Physical Society* (http://physics.aps.org/synopsis-for/10.1103/PhysRevB.83.220513)

We observed three different phenomenon of peak effect, paramagnetic Meissner effect (PME) and the surface superconductivity in Nb crystal. The paramagnetic Meissner effect appeared when the superconductivity in the bulk ceases; it is observed up to very large fields. We explained the observations of PME signal along with surface superconductivity on the basis of flux compression in the interior of the sample when the surface superconductivity exists near to the surface. We observed that the intensity of the PME signal is high at the low-field/high-temperature side and intensity decreased as we increased the field or decreased the temperature. We suggested that the observed evolution in the strength of the PME signal may be understood on the basis of the temperature dependence of the superconducting coherence length. We also found the distinct path dependent magnetization response in the vicinity of the onset of the PME from the low temperature side in the field-cooled cool down and the field-cooled warm up responses. Thus, the PME not only appeared along with surface superconductivity phenomenon, but it is also associated with a path dependent phenomenon. We believe that the path dependent magnetization

response is an evidence for the nucleation of vortices in the superconductor before superconductivity permeates in the sample throughout. We published our research work in an article in *Physical Review B*, and in *focus new item in Nature India section of Nature Magazine* *http://www.nature.com/nindia/2008/081228/full/nindia.2008.342.html*

The discovery of superconductivity in the iron based pnictides in the year 2008 has been a stimulating trigger to the field of superconductivity. Many different types of iron based superconductors stand reported in the literature so far: e.g., ReFeAsO (Re = rare earth) i.e., 1111 phase; secondly, MFe_2As_2 (M = Ba, Ca, Sr), i.e., 122 phase and FeSe. We explored the *vortex phase diagram* in a single crystal of $FeSe_{0.5}Te_{0.50}$ with a T_c =14.3 K via detailed magnetization measurements. The possible role of the crystalline anisotropy on vortex pinning is explored via magnetic torque magnetometer. We presented evidence in favor of pinning related to spatial variations of the charge carrier mean free path leading to small bundle vortex pinning by randomly distributed (weak) pinning centers. This work can be seen online in arXiv (http://arxiv.org/abs/1104.1332) and presently under review process.

We explored the magnetic field dependence of the critical current density from dc magnetization measurements concerning the anisotropic behaviour of flux line lattice (FLL) in a single crystal of YNi_2B_2C, even though borocarbide superconductors show structural anisotropy of c/a ~ 3, their intrinsic superconducting parameters show little anisotropy (~1.2). The peak effect (PE) phenomenon is observed for all crystallographic orientations, but the second magnetization peak (SMP) anomaly is observed only for H//a. Our study revealed that the FLL is developed when H//[110] is better ordered within the basal plane. However, the FLL for H//c is found to be even more ordered than that for H//[110]. The perfect square symmetry of the FLL for H//c is perhaps responsible for promoting the realization of the best spatial order of the FLL prior to the onset of the PE, indicating a correlation between the crystalline lattice and the vortex lattice. We have also found a change over in the power law governing the decay of the critical current density which is identified as a crossover from weak to weaker pinning regime in the phase diagram (Physica C **469**, 151 (2009)). We are also investigating the magnetic anisotropies as well as structural properties of magnetic nanowires and nanochains and have communicated two manuscripts for publication.