

### N.15: Accomplishments of AECS, Indore

Students of AECS, Indore participated in various zonal, regional and national level academic and sports events and have won several awards, bringing laurels to themselves and the school. Important achievements of the students during July 2019 to June 2020 period are given below.

Tanmay Ganguli of Class X was declared successful in the National Talent Search Examination-2019 and has become eligible for the scholarship. Further, Abhinav Deshpande, Samyak Jain, Vedant Upadhyay, Tapananshu Manoj Gandhi, Anushka Gupta, R Kamalika, Tanishka Ruwali, Isha Raikwar, Mehul Patel of Class X have cleared the Level-1 (State Level) National Talent Search Examination 2019-20.

In this academic year, the students, Arnav Sharma, Satyam Sinoliya, Vishesh Shrivastava and Gargi Tiwari of class IX, Soham Kumar and Samyak Jain of class X, Tanmay Ganguli, Mallika Garg and Urvi Tiwari of class XI qualified the PRMO and became eligible for the Regional Mathematics Olympiad-2019, which was organized by IAPT. Out of the above nine students, three students, Tanmay Ganguli, Mallika Garg of class XI and Gargi Tiwari of Class IX qualified in the Regional Mathematics Olympiad-2019 and are eligible for the national level.

In all 19 students qualified CBSE-TERI, The Green Olympiad held on 16<sup>th</sup> October 2019. The names of the successful students are as follows: Level-1: Darsh Sahu, Divyansh Jangir and Sachidanand Tiwari; Level-2: Arushi Shukla, Shivani Parate, Nikhil Meena, M. Suresh, Rajshekhar Mahanty, Gyanvi Jain, Ramsha Fatima; Level-3: Arnav Sharma, Aswin J. Bhat, Paridhi Alhate, Punyasa Nayak, Sanjit Satheesan, Aastha Shrivastava, Anushka Garg, Anshul Eskey and Yashi Arora.

Harkeerat Singh of Class VIII secured selection among 55 students from Indore district for INSPIRE Award for 2019-20. He received a cash prize of ₹ 10,000 for the innovative idea in his application. Patatra Chowdhury of Class XII became one among the top 5 winners in the State Level STEM Skill Quiz organized by Indian Physics Association, Indore Chapter. Sohun Kumar and Samyak Jain of class X secured 2<sup>nd</sup> position in the zonal level of the All India Inter AECS Hindi Vigyan Prashna Manch Pratiyogita-2019 held on 30<sup>th</sup> August 2019 at AECS-3 Rawatbhata, Rajasthan. Team comprising of Avirishu Petwal of class IX and Aanchal Kumawat of class X bagged the 2<sup>nd</sup> position in the junior category and the team comprising of Deepika Sisodia and Mousam Kumari of class XII bagged the 3<sup>rd</sup> position in the seniors category in the zonal level of the All India Inter AECS Hindi Debate-2019 held on 31<sup>st</sup> August 2019 at AECS-3, Rawatbhata. Anuva Pant of Class VIII won Bronze Medal in the shotput competition during the CBSE Cluster Meet held during 23<sup>rd</sup> - 26<sup>th</sup> September 2019 at Satna, M.P.

Reported by:

Jithendra Kumar V.V. (jkkv@rrcat.gov.in)

### N.16: RRCAT Seminars during July 2019 to June 2020

**Failure analysis of dipole vacuum chamber of Indus-2: *Shri Rakesh Kaul*, Associate Director, Materials Science Group and Head, Laser Materials Processing Division & Materials Engineering Section, RRCAT, August 23, 2019.**



The dipole vacuum chambers of Indus-2 were installed and commissioned in 2005. In 2014, one of the in-service dipole vacuum chambers developed leak in its weld. In the next two years, three more leaks were detected in different in-service dipole vacuum chambers. This failure investigation was taken up to determine the cause of failure of dipole vacuum chambers and suggest remedial measures to avoid such failures in future. The failure investigation was performed on one of the rejected dipole vacuum chambers which had displayed leak immediately after welding. These investigations were presented in the talk and also briefly discussed results of on-going study aimed at development of low permeability welds of type 316L SS for applications in particle accelerators.

**Ultrasonic inspection of weld and braze joints: *Dr. Anish Kumar*, Head, Ultrasonic Measurements Section, NDE Division, Metallurgy and Materials Group, IGCAR, Kalpakkam, August 28, 2019 .**



The talk presented basics of conventional and advanced ultrasonic techniques for inspection of weld and braze joints. The techniques were illustrated with a few applications of ultrasonic inspection of weld joints of different configurations. Various modes of phased array ultrasonic technique and its advances were also discussed in the talk. Advanced ultrasonic imaging techniques developed at IGCAR for inspection of weld joints of different thicknesses in the range of ~0.4 mm - 200 mm were presented. Development and applications of advanced ultrasonic techniques including guided wave, electromagnetic acoustic transducers (EMATs), phased array EMATs, magnetostriction based ultrasonic inspection, portable C-scan imaging and automated ultrasonic imaging, were also presented.

**Probing lattice instabilities through neutron, x-ray, and free-electron laser sources: *Dr. Dipanshu Bansal*, Assistant Professor, Dept. of Mechanical Engineering, IIT, Bombay, August 29, 2019.**



Understanding of lattice instabilities is critical to rationalize the underlying

physics of wide-range of materials, including thermoelectrics. Thermoelectrics hold immense potential for technological breakthroughs in power requirement for deep space missions and waste-energy recovery and are being rapidly commercialized. In this talk, speaker presented combined experimental (inelastic neutron scattering, nuclear resonance inelastic x-ray scattering, time-resolved x-ray scattering measurements from FEL) and theoretical studies (anharmonic phonon simulations) of thermoelectric SnSe as a function of temperature, pressure, and photoexcitation. Combining measurements with anharmonic phonon simulations, the thermal transport and consequently high thermoelectric conversion efficiency in SnSe are rationalized. Experimental and theoretical tools used in the study have broad applicability and can be applied to, for example, ferroelectrics and superionic conductors to decipher the origin of the spontaneous polarization and liquid-like thermal transport.

**Thermoelectric transport properties of two-dimensional nanomaterials: Dr. Sugata Mukherjee, Honorary Fellow, S.N. Bose National Centre for Basic Sciences in Kolkata, August 30, 2019.**

In this talk, Dr. Mukherjee provided a brief review of the importance of thermoelectricity as renewable energy source and illustrated the importance of thermoelectric transport parameters for thermoelectric devices. He then presented first-principles Density Functional Theory based electronic structure and Boltzmann transport theory based methods, for both electron and phonon transport, to calculate the thermoelectric transport parameters for MLG and BLG and also for the heterostructures of Graphene and h-BN, without any adjustable parameters. He also discussed equilibrium molecular dynamics based method for studying thermal transport in heterostructures of Graphene and h-BN. Speaker also discussed thermoelectric properties of Transition-metal Dichalcogenides  $ZrX_2$  ( $X=S, Se, Te$ ) monolayers, which showed a large enhancement of  $ZT$  ( $\sim 2$ ) upon application of stress in these materials. The results were discussed in the light of available experimental measurements.



**Hydrodynamic and ballistic transport of electrons in two dimensions: Prof. Deshdeep Sahdev, Professor, IIT, Kanpur, October 03, 2019.**

In this talk speaker discussed that electron transport in 2D systems with weak electron-lattice interactions can make transition from an Ohmic to a ballistic or a hydrodynamic regime. Speaker showed the occurrence of these transitions by viewing electrons at the



kinetic level in experimentally realizable 2D systems. He talked about solving the kinetic model using "bolt", a computer package, developed by his team for solving the Boltzmann equation, keeping intact its full time-dependence and non-linearity. Speaker traced the choreography of vortices produced by AC drives in each of the non-ohmic regimes, and clear experimental signatures, based on measurable currents and voltages of ballistic and hydrodynamic behaviour.

**Metal-semiconductor hybrid nanostructures – stepping towards efficient devices: Dr. J. Jayabalan, Head, Nano Science Lab., Materials Science Section, RRCAT, November 26, 2019.**



Understanding the interaction between metal and semiconductor nanostructures at ultrafast timescale is important for plasmon-enhanced optoelectronics and sensing applications. Semiconductors form the basic building block of several of these optoelectronic applications. On the other hand, metal nanostructures have ability to manipulate electromagnetic field at nanoscales to generate hot-spot. This talk gave a brief introduction to the applications of metal-semiconductor hybrid nanostructures as recent material for energy efficient and energy harvesting applications. Following this, recent studies carried out by speaker and his team on metal-semiconductor hybrid nanostructures which can generate hot-spots and can transport hot-electrons were presented. Questions like, what will happen if a semiconductor quantum dot is placed in the hot-spot generated by two Ag nanoparticles how many hot-electrons can be transported from one Ag nanoparticle to semiconductor were addressed.

**Resonant photovoltaic effect in doped magnetic semiconductors: Dr. Pankaj Bhalla, Visiting Fellow, University of New South Wales, Sydney, Australia, February 26, 2020.**

The rectified non-linear response of a clean, time-reversal symmetric, undoped semiconductor to an ac electric field includes a well-known intrinsic shift current. In this talk, it was shown that when Kramers degeneracy is broken, a distinct second-order rectified response appears due to Bloch state anomalous velocities in a system with an oscillating Fermi surface. This new effect, which speaker referred as the resonant photovoltaic effect (RPE), produces a resonant galvanic current peak at the interband absorption threshold in doped semiconductors or semimetals with approximate particle-hole symmetry. Dr. Bhalla discussed it for a model of the surface states of a magnetized topological insulator.

*Reported by:*

*Arup Banerjee (banerjee@rrcat.gov.in)*