A.2: Activities at Indus beamlines

Indus-1 and Indus-2 are national facilities, which have been attracting a large number of researchers from all over the country. A new beamline: "X-ray Magnetic Circular Dichroism (XMCD) beamline" got the approval from AERB for regular user operation in November 2022, thus, taking the total number of operational user beamlines in Indus-1 and Indus-2 to 25. In the period from July 2022 to December 2022, the total number of user experiments that were carried out at the Indus-1 and Indus-2 beamlines were 517. These include a few users from the industry, who have used the EXAFS and XRD beamlines.

During this period, about 100 papers were published in peer reviewed international journals. The topics covered in these publications cover a diverse range of disciplines, which include: materials science, biology, chemistry, nanoparticles, device applications, etc. Some of the interesting research results that have been published in the last six months are summarized below.

Different groups have worked on various aspects of materials for batteries and other energy materials. These include studies on $MoTe_2$ anode materials for Li ion batteries for fast charging (Ref.: M. R. Panda et al., ACS Appl. Energy Mater., Vol. 5, p 9625 (2022)), electronic structure of $LiFePO_4$ used as electrode material in Li ion batteries has been reported (Ref.: Mahboob Ali et al., Phys. Chem. Chem. Phys., Vol. 24, p 9695 (2022)). Local structural study of α-MoO_3 micro-strips, which have applications in both batteries and as catalysts has been published. (Ref.: Umesh Gawai et al., Eur. Phys. J. Appl. Phys., Vol. 97, p 65 (2022)). Studies on the microstructural parameters of ball-milled Si powder on reactivity with water for on-demand H_2 production has been published (Ref.: Abhay Bhisikar et al., Mat. Today Comm., Vol. 33, p 104138 (2022)).

Studies on catalysts for energy friendly technologies have been published. These include: studies on Metal−Organic Framework-Encaged Monomeric Cobalt(III) Hydroperoxides for Chemoselective methane Oxidation to Methanol to acetic acid, (Ref.: Neha Antil et al., ACS Catal., Vol. 12, p 11159 (2022)); N-Formylation of amines utilizing CO_2 by a heterogeneous metal–organic framework supported single-site cobalt catalyst, (Ref.: Rajashree Newar et al., Catal. Sci. Technol., Vol. 12, p 6795 (2022)); and use of Sn-doped bismuth ferrite nanoparticles for visible light induced ultrafast methyl blue degradation, (Ref.: Sonam Chakraborty et al., Ceramics International, Vol. 48, p 37253 (2022)). Dithiophosphonate Anchored Heterometallic (Ag(I)/Fe(II)) Molecular Catalysts for Electrochemical Hydrogen Evolution Reaction were studied and published (Ref.: D. K. Jangid, Inorg. Chem., Vol. 61, p 13342 (2022)).

Results on materials for novel devices have been published. These include: studies on prestructural ordering in GaSb thin films for memory device applications (Ref.: Joshua Asirvatham et al., J. Phys. Chem. C, Vol. 126, p 15405 (2022)); the analysis of the role of MgO barrier layer on the visible photoresponse in n-$Mg_xZn_{1-x}O$/p-Si Heterojunction UV Photodetectors (Ref.: Shantanu K. Chetia et al., Physica Status Solidi A, Vol. 219, 2200285 (2022)) and studies of different polymorphs of Y-doped HfO_2 epitaxial thin films for semiconductor device applications (Ref: Mangla Nand et al., J. Alloys Comp., Vol. 928, p 167099 (2022)).

Several results on novel materials for diverse applications have been published. The effect of Mn doping on the structural, spectral, electrical, ferromagnetic and piezoelectric properties of $0.7BiFeO_3$-$0.3BaTiO_3$ lead-free ceramics has been published (Ref.: Farha Jabeen et al., J. Alloys Comp., Vol. 917, p 165303 (2022)). Relaxor ferroelectric behavior in Pb free rare earth substituted 4-layered $BaBi_{3.9}RE_{0.1}Ti_4O_{15}$ Aurivillius compounds have been studied (Ref.: Tirupathi Patri et al. Sci. Rep. Vol.12, p 16508 (2022)). Li^+-doped Gd_2O_3 crystals, which are useful for photoluminescence upconversion have been studied to understand the role of local disorder on the upconvertion properties (Ref.: Preeti Verma et al., J. Phys. Chem. C, Vol. 126, p 19849 (2022)).

Pressure induced structural phase transition in Cr-doped Mn_2O_3 multiferroics have been studied and reported (Ref.: Mohit Chandra et al., Phys. Scr., Vol. 97, p 095815 (2022)). A combined theoretical and experimental investigations on Mn-doped Bi_2Se_3 topological insulator has been published (Ref.: Ravi Kumar et al., Phys. Rev. Materials, Vol. 6, p 114201 (2022)). Results related to establishment of a technique to reduce the lower detection limits of trace elements by energy dispersive XRF has been published (Ref.: Md. Akhlak Alam et al., J. Anal. At. Spectrom., Vol. 37, p 575 (2022)).

An experimental study to understand the role of particle size and dimension on the packing fraction of a collection of particles has been published (Ref.: Avik Das et al., Langmuir, Vol. 38, p 3832 (2022)). Among the several biological applications: the structure of phosphopeptide complex was reported to have a better understanding of cancer proliferation (Ref.: Subashini Mathivanan, ACS Omega, Vol. 7, p 24344 (2022)).

Reported by:
Tapas Ganguli (tapas@rrcat.gov.in)