

A.2: Brief report on Indus beamline utilization

Indus-1 and Indus-2 are national facilities, which have been attracting a large number of researchers from all over the country. In spite of the ongoing Covid-19 pandemic, the period July 2021 to December 2021, saw a relatively regular and increased usage of the beamlines for user experiments. Impediments in the user activity was witnessed due to the fact that almost all samples from users have only been received by post and only a few users physically came to Indus for experiments. The total number of user experiments carried out at Indus-1 and Indus-2 beamlines in this period were 365. These include a few users from industry for x-ray diffraction measurements.

In November 2021, the higher order suppressor (HOS) system was commissioned in the Soft x-ray reflectivity beamline BL-03, Indus-2. The details of this development are given in report A.8 in this Newsletter. During this period, over 100 papers were published in peer reviewed international journals. Some of the interesting research results that have been published in the above period are summarized below:

One of the most common area of study is of functional materials. Observation of room-temperature ferroelectricity in spark-plasma sintered GdCrO_3 and its correlation with the crystal structure has been reported (Ref: S. Mishra et al., Phys. Rev. B, Vol. 104, L180101 (2021)). The role of solute-drag effect in stabilizing the orthorhombic phase in bulk La-doped HfO_2 for applications as a ferroelectric material has been reported (Ref: D. Banerjee et al., Phys. Chem. Chem. Phys., Vol. 23, p 16258 (2021)). The work highlighting the role of lattice assisted dielectric relaxation in a four-layer Aurivillius $\text{Bi}_2\text{FeTi}_3\text{O}_{15}$ ceramic at low temperatures has been published (Ref.: D. Prajapat et al., J. Phys. Cond. Matt., Vol. 33, p 355803 (2021)). The photoluminescence properties of $\text{Er}_2\text{X}_2\text{O}_7:\text{Eu}^{3+}$ ($\text{X} = \text{Ti}$ and Zr) pyrochlore and its correlation with the local structure has been studied for the development of efficient phosphors for lighting application (Ref: S. K. Gupta et al., Mater. Adv. Vol. 2, p 3075 (2021)). The mixed Mott–Hubbard and charge transfer nature of 4H–SrMnO_3 thin film on Si (100) have been determined. (Ref: A. K. Mandal et al., J. Phys.: Condens. Matter, Vol. 33, p 235501 (2021)). The evaluation of the interfacial structure of Cr-Ti multilayers and its effect on x-ray reflectivity applications have been studied (Ref: Piyali Sarkar et al., Thin Solid Films, Vol. 734, p 138840 (2021)). The effects of interface modification of Fe/Cr/Al magnetic multilayer by swift heavy ion irradiation and its effect on the magneto-optical properties of these multilayers have been reported (Ref: Parasmani Rajput et al., Surfaces and Interfaces, Vol. 26, p 101431 (2021)). Some of the energy materials and processes that have been studied include; Temperature dependent CuCl_2 hydrolysis and thermolysis reaction and its role in water splitting (Ref: Rajendra V. Singh et al., J. Thermal Analysis & Calorimetry, doi.org/10.1007/s10973-021-10969-y (2021)).

Total reflection x-ray fluorescence measurements were carried out to determine the trace impurity concentration in treated wastewater (Ref: V. K. Garg et al., Nature Env. & Pollution Tech., Vol. 20, p 743 (2021)). The suitability of $\text{g-C}_3\text{N}_4/\text{Ca}_2\text{Fe}_2\text{O}_5$ heterostructures for enhanced photocatalytic degradation of organic effluents under sunlight has been published (Ref: Durga S. Vavilapalli et al., Sci. Repts., Vol. 11, p 19639 (2021)).

Important materials and related studies on nuclear technology include the following: Diffraction line profile analysis to determine the microstructure evolution and corresponding changes in mechanical properties of proton irradiated Nb-1Zr-0.1C alloy have been studied as a function of irradiation dose (Ref. Argha Dutta et al., J. Nucl. Mat., Vol. 557, p 153221 (2021)). Studies on the uranium speciation in zinc iron phosphate (ZnIP) glass, which is extremely useful for nuclear waste management has been carried out (Ref: N. Praveena et al., Ceramics Int. Vol. 47, p 18323 (2021)). The effect of structure and stability of iron phosphate glass with Sb and Te-ion loading for nuclear waste storage application has been reported (Ref: A.C. Joshi et al., J. Non-Cryst. Sol., Vol. 570, p 121016 (2021)). The mechanism of trapping of U ions in natural deep eutectic solvents and its effects on the radioactive decontamination process has been published (Ref: A. Srivastava et al., ACS Sust. Chem. Eng., Vol. 9, p 7846 (2021)).

Some of the published studies related to engineering materials include: Analysis of the role of Cr on ordering characteristics of single phase Ni-16 wt.% Mo-7wt.% Cr alloy, which is important as a high temperature engineering material, is published (Ref: Acta Materialia, Vol. 219, p 117263 (2021)). X-ray imaging to study the effect of graphene addition on thermal behavior of 3D printed graphene/AlSi10Mg composite has been carried out (Ref: J. K. Tiwari et al., J. of Alloys and Comp., Vol. 890, p 161725 (2021)).

Some of the interesting applications related to biology and health that have been published include the following: Microtomography has been used among other techniques to understand the structure of sodium alginate (SA) based “all-natural” composite bio-sponges for potential application as wound care scaffold (Ref: Mat. Sci. & Engg. C, Vol. 118, p 111348 (2021)). The structure of Tsp1 and Se-Tsp1 proteins and their role on modulating plant defence to microbes has been published (Ref: G. D. Gupta et al., Int. J. of Bio. Macromol., Vol. 191, p 267 (2021)). Structural insights into kinetoplastid coronin oligomerization domain important for curing certain parasitic tropical vector borne diseases has been published (Ref: P. S. Parihar et al., Current Res. Struct. Biology, Vol. 3, p 268 (2021)).

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