

## Institute Colloquium (Hybrid mode)

Due to the Yoga Day celebration at 4:00 PM on 06.05.2022, the Materials Science Colloquium by Dr. Urmimala Maitra, Assistant Professor, School of Materials Sciences has been rescheduled on 13<sup>th</sup> May, 2022 at 4 PM.

**Title:** Quest for High Voltage Redox in Intercalation cathodes for Na and Li-ion batteries

**Speaker:** Dr. Urmimala Maitra

**Date & Time :** Friday 6-th May, 2022 at 16:00 HRS

**Venue:** C.V. Raman Hall, IACS

### Zoom details

Join Zoom Meeting

<https://zoom.us/j/93511384727>

Meeting ID: **935 1138 4727**

Passcode: **13052022**

**Abstract :** Increasing demand for sustainable energy is naturally allied with increasing demand for energy storage mechanisms. Rechargeable Li/Na-ion batteries utilising intercalation cathodes have been the forerunner in this. Here, high voltage redox of Ni and /or Co has traditionally been used to achieve high energy density. Increasing their energy density further is largely contingent on boosting the charge storage capacity of the cathode material while also increasing or at least maintaining the operating voltage. Utilising the redox activity of the lattice oxide ions, provides a compelling mechanism to achieve both high capacity and high voltage simultaneously.<sup>1,2</sup> More importantly, this allows us to access high energy density in Fe- and Mn-rich systems which are both low cost, abundant and environment friendly alternatives to Ni and Co. In my presentation, I will outline the mechanisms contributing to electrochemical irreversibility of anion redox *e.g.* irreversible structural transitions, loss of lattice oxygen as O<sub>2</sub>-gas *etc.*<sup>2,3</sup> and then discuss the design strategies to provide structural stability and achieve reversible oxygen redox at high voltages,<sup>4</sup> thus opening up possibilities of batteries with significantly higher energy and power density compared to current state-of-the-art batteries. References:

1. U. Maitra, R. A. House, J. Somerville, ... , P. G. Bruce\*, "Oxygen redox chemistry without excess alkali-metal ions in Na<sub>2</sub>/3[Mg<sub>0.28</sub>Mn<sub>0.72</sub>]O<sub>2</sub>.", *Nature Chem.*, 2018, 10, 288.
2. R. A. House, G. J. Rees, M. A. Pérez-Osorio.....P. G. Bruce. "First-cycle voltage hysteresis in Li-rich 3d cathodes associated with molecular O<sub>2</sub> trapped in the bulk" *Nature Energy* 2020, 5, 777-785.

3. R. A. House, U. Maitra, L. Jin, ... P. G. Bruce\*, "What triggers oxygen loss in oxygen redox cathode materials?", *Chem. Mater.* 2019, 31, 3293.
4. R. A. House, U Maitra, M. A. Pérez-Osorio, J. G. Lozano ... P. G. Bruce\*, "Superstructure control of first-cycle voltage hysteresis in oxygen-redox cathodes.", *Nature* 2020, 577, 502.