Materials Panel Abstract & Speaker Biography

High performance cardanol based sustainable copolymers as cathodic materials for Li-S batteries

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In the current scenario of an energy driven society, high performing energy sources have captured the attention of research community like never before. In addition, rapidly dwindling fossil reserves have further propelled the demand for exploration of sustainable-origin materials for energy storage applications. Li-S batteries have exhibited immense promise in this respect. The major building block for Li-S batteries is elemental sulphur which is produced at the rate of ~70 M.T. per annum from petroleum industries.[1] This vast availability of the feed stock which is also an industrial waste holds the key towards sustainable and scalable production of Li-S batteries. Contrarily, several drawbacks such as leaching of sulphur from electrode, solubilisation of higher-order polysulfides into electrolyte and subsequent low active material utilisation have severely curtailed further expansion of Li-S batteries.[2]

Our research group has focussed on the strategy of altering cathodic composition to counter the aforementioned limitations. Benzoxazine sourced from agro-industrial phenolic waste, cardanol, have shown potential to act as a co-monomer to copolymerise with elemental sulphur owing to their unique molecular design and thermal stability. In this context, the methodology of inverse vulcanisation[1] was adopted to entrap elemental sulphur derived polysulphide diradicals utilising cardanol based benzoxazine monomer.[3-5] In presence of sustainably sourced reduced graphene oxide (2.5 wt.%)[6] as a conductive filler, a high initial discharge capacity of ~975 mA h g^{-1} after 100 cycles at 200 mA g^{-1} current rate with capacity fading of 0.15% per cycle was observed.[7] Moreover, a considerable decrease in active material dissolution in electrolyte and enhanced cathodic integrity also accompanied the improved battery performance.[5] Additionally, the low viscosity of cardanol based benzoxazine ensured a one pot, solventless and melt copolymerisation enhancing industrial viability of the process. Thus, renewable benzoxazine-sulphur copolymers with high loading of sulphur (> 90%) have come up as a novel class of high performing sustainable origin cathodic materials for Li-S batteries.

References

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Speaker Biography:

Bimlesh Lochab obtained an MSc (1997–1999) and M.Tech. (1999–2000) from IIT, Delhi, India. She held a Felix scholarship for her DPhil degree (2002–2006) from the University of Oxford on the topic of polymers for electro-optic applications. She did her post-doctoral fellowship at the University of Oxford and University of Nottingham, UK. After her return to India, she received the Young Scientist Award to research on cardanol-based benzoxazine polymers. In 2012, she joined, as an Assistant Professor, Shiv Nadar University (SNU), UP, India.

Her research interests include polymers using intermediates from sustainable origin; dendritic architectures and polymers for energy storage devices, PVs, OLEDs, and nanoparticles for nanocomposite applications. She is currently teaching several courses such as structure and bonding, chemical principles, crime and chemistry, chemistry of our life, nanomaterials, polymer chemistry and green chemistry etc.