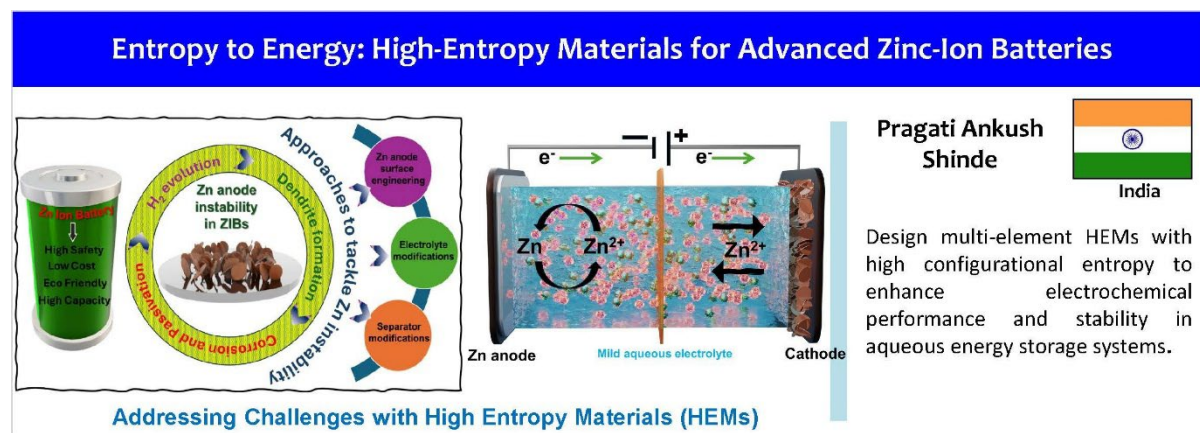


Entropy to Energy: High-Entropy Materials for Advanced Zinc-Ion Batteries

ICYS Research Fellow Dr. Pragati Ankush Shinde



■ Research

My research focuses on the development of advanced aqueous zinc-ion batteries (ZIBs) through interfacial and structural modification of electrode materials. Aqueous ZIBs are attracting significant attention as safe and sustainable energy storage systems owing to their intrinsic nonflammability, high ionic conductivity, and low cost. However, their performance is often limited by sluggish ion diffusion, interfacial instability, and undesired side reactions during cycling. Initially, I aim to explore conventional MnO_2 -based electrodes and introduce novel strategies to overcome these limitations. My work emphasizes understanding the interfacial electronic coupling and phase transformations occurring during electrochemical processes by employing in-situ/operando characterization techniques and theoretical simulations. By correlating the local structural and electronic features with the overall electrochemical behavior, I aim to establish rational design principles for achieving high-capacity, durable, and efficient aqueous ZIBs. In the long term, this understanding will be extended toward the **entropy-driven design of high-entropy materials**, paving the way for next-generation aqueous batteries with superior stability and energy density.

■ Comments

When I joined NIMS as a JSPS Postdoctoral Fellow, I was inspired by the independent and innovative research culture encouraged through the ICYS program. Attending ICYS seminars and interacting with researchers from diverse disciplines motivated me to apply for this program. The opportunity to pursue self-directed research while receiving guidance from experienced mentors and utilizing world-class facilities perfectly aligns with my scientific aspirations. ICYS provides an ideal platform for early-career researchers to explore creative ideas with broad scientific and administrative support. I am excited to continue my journey here through advancing next-generation energy materials and further strengthening my expertise as an independent researcher in this field.

One of the most rewarding aspects of ICYS is its dynamic and collaborative research environment. Being surrounded by talented researchers from various scientific backgrounds opens numerous opportunities for idea exchange and interdisciplinary collaboration. Regular ICYS seminars, workshops, and informal discussions continually spark fresh perspectives and novel research directions. Moreover, close interaction with leading scientists at NIMS offers invaluable insights and mentorship that enrich my research experience. With its strong emphasis on independence, innovation, and collaboration, ICYS offers an exceptional platform to explore pioneering ideas, access facilities, and contribute to the cutting-edge advancements

in materials science.

■Link

<https://www.nims.go.jp/icys/research/#SHINDE>