Contribution ID: **3** Type: **Abstract TEC2ZERO**

Breaking the Mold: Unconventional Strategies for Sustainable Li-Ion Battery Recovery

As the demand for lithium-ion batteries (LIBs) surges due to the rise of electromobility and renewable energy storage, conventional recycling methods struggle to keep pace with sustainability goals. Current industrial processes rely heavily on energy-intensive and chemically aggressive techniques, raising concerns about environmental impact and scalability. This presentation explores innovative and unconventional approaches to LIB recycling that challenge traditional paradigms and prioritize *Green Chemistry*, efficiency, and material circularity. Two key case studies will be highlighted. The first investigates an electrochemical route for selectively recovering critical metals from spent LIB cathodes. By leveraging controlled electrochemical deposition, this method enables the targeted separation of copper and manganese, yielding high-purity materials suitable for direct reuse. The second study presents a novel combination of hydrometallurgical extraction and electrocrystallization to recover lithium with minimal chemical waste. Using a liquid gallium electrode, lithium is extracted and precipitated as lithium carbonate, demonstrating an efficient, closed-loop recovery system. By integrating electrochemical and *Green Chemistry* principles, these alternative strategies offer scalable and sustainable solutions that reduce environmental impact and support a truly circular battery economy. This talk will challenge conventional recycling perspectives and propose a vision for the future of LIB sustainability—one where waste becomes a valuable feedstock rather than an environmental burden.

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Track Classification: Future Technologies: Critical Raw Materials (including possible toxicity and environmental impact)