Materials Science & Engineering Seminar Series

Carnegie Mellon University
Materials Science & Engineering

presents

Recycling of Li Ion Batteries: Creating Smart Solutions Through Innovation and Technology Disruption

Dr. Kinnor Chattopadhyay
University of Toronto

ABSTRACT: Today, lithium ion batteries (LIBs) are considered by many as the best technology for sustainable transport since they provide high energy and power per unit of battery weight, allowing them to be lighter and smaller than other rechargeable batteries. LIB performance is especially dependent on the active cathode material, which commercially consists of one of a handful of electrochemically active compound types containing Co, Ni, Mn and Fe in different proportions, in addition to Li. Significant number of researchers have tried to design processes to repair or recycle cathode materials in spent LIBs. In general, there are four types of recycling technologies including, mechanical treatment, hydrometallurgical treatment, combination of thermal pre-treatment and hydrometallurgical methods, and finally pyrometallurgical treatment. Hydrometallurgical technologies implement mechanical pre-treatment and metals recovery from the black mass by acid/alkaline leaching, precipitation, solvent extraction and ion exchange resins. However hydrometallurgical processes generate huge effluent volumes, and utilize a large amount of water, which both have negative environmental impacts. On the other hand, pyrometallurgical processes are focused on the production of metallic alloys by melting the black mass at high temperatures, thus consuming a significant amount of energy. There is clearly a dichotomy on which route is better (may be none), and these technologies need to be disrupted, and the status quo should be challenged. With this in mind XProEM patented a proprietary Solid-State Subtractive Metallurgy (S^3M) process which provides a unique and sustainable solution to tackle the imminent problem of recycling spent LIBs by directly recovering cobalt and nickel into their battery precursor material forms via a solid-state reduction process. As the process is completed in solid state, it is expected to consume much less energy than existing pyrometallurgical processes and eliminates the requirement for toxic solvent consumption and hazardous wastewater treatment.

BIOGRAPHY: Dr Kinnor Chattopadhyay is a process metallurgist and has 12 years of experience in process metallurgy, sustainable metallurgy and resource recycling. He obtained his master and PhD from McGill University in process metallurgy, which is one of the top 35 universities in the world and subsequently worked for a world class mining and metals consulting firm HATCH for two years. He has extensive knowledge of transport phenomena, metallurgical thermodynamics, and solid state reactions and has worked with numerous partners internationally including Rio Tinto, ArcelorMittal, and TATA Steel. He has 150+ publications, 20 + process know hows, and 3 patents to his credit and has presented at various international forums across the globe. He is currently the Dean's Catalyst Professor and AIST Foundation Steel Professor in the Faculty of Applied Science and Engineering at the University of Toronto and works in the area of process metallurgy and recycling. Kinnor focuses on experimental and mathematical modelling of metallurgical process for designing and innovating new processes, better understanding of existing process, operational improvements, and to perform ‘what if’ and ‘root cause’ analyses of problems. He is also currently the first and founding member of CARLIB (Canadian Association of Recycling for Lithium Ion Batteries) a which is a collective association trying to address the necessities and regulations in the battery industry in Canada and North America. Kinnor is also the Founder and CTO of XProEM Ltd. and has been involved in Li and Co recycling since 2015.

CMU Remote, 12:00 PM
Friday, December 11, 2020