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Development of innovative processes for the material recovery from spent rechargeable batteries

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Batteries are everywhere in our modern society and their consumption is ever on the increase. They can be either primary (disposable) or secondary (rechargeable) batteries. Regardless, the majority of batteries are disposed of to landfills at the end of their useful lives with less than 5% of them being recycled. This represents a significant loss of valuable, non-renewable resources, in addition to the potential to cause serious environmental damages from leakage of chemicals in the electrolyte and leaching of heavy metals. The material loss is even more substantial for the rechargeable batteries as they contain large amount of transition metals in the cathode such as cobalt (Co), nickel (Ni) and manganese (Mn).

Research efforts to recover these valuable materials have surged in recent years from the increased demand on rechargeable batteries and the associated increase on the spent batteries when they reached their useful lives. Many process flow charts have been reported in the literature, which are largely based on the pyrometallurgical or hydrometallurgical extraction methods, or their combinations, of the constituent metals.

In this presentation, I will first provide an overview of the spent batteries in the world with some statistics on Australia, China, Europe and the United States. I will then discuss some technical specifics of several representative processes that are reported in the literature, with a focus on the materials recovery from spent lithium ion batteries. I will conclude my presentation by offering my personal views on the key issues that must be addressed to improve the commercial viability of the battery recycling processes and ultimately the sustainability of the battery industry.