A Path Toward Sustainable Battery Technologies

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Rapid increase in global energy use and growing environmental concerns have prompted the development of clean, sustainable, alternative energy technologies. Renewable energy sources like solar and wind are a promising solution, but they are intermittent. Batteries are the most viable option to efficiently store and utilize electricity produced from them as well as for electrification of transportation sector. However, their widespread adoption requires optimization of cost, cycle life, safety, energy density, power density, and environmental impact, all of which are directly linked to severe materials challenges. Among them, cost and sustainability will be the single dominant factor as the battery market is rapidly expanding. This presentation will center on a path toward the development of sustainable, supply-chain-free next-generation battery chemistries and materials. Strategies and approaches for progressively eliminating expensive and scarcely available cobalt, followed by eliminating nickel, and ultimately any mined metal, including lithium, will be discussed. As an example, the progress on cobalt-free lithium-ion cells, cobalt- and nickel-free lithium-ion cells, lithium-sulfur cells, and sodium-sulfur cells will be presented. The challenges of bulk and surface instability and the role of electrolytes will be discussed. Approaches to overcome the challenges and the use of advanced characterization methodologies to develop an in-depth understanding will be presented.