Tribute to Michel Armand : From Solid Polymer Electrolyte to Carbon Nanopainting LiFePO4.

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Michel Armand is a pioneer in the development of polymer electrolytes for battery applications. When John Goodenough discovered that olivine $LiFePO_4$ is a viable cathode for Li-ion batteries, Michel immediately recognized it had a redox energy well-matched to a polymer electrolyte. He used his experience in carbon coating (nanopainting) to increase the capacity and rate capability of $LiFePO_4$. Research on lithium metal combined with polymer electrolytes in lithium rechargeable batteries started in 1979. Since that time, battery research has expanded worldwide. Several new polymers, solid electrolytes and ionic liquids with improved conductivity were identified. These advances resulted from a better understanding of the major parameters controlling ion migration, such as favorable polymer structure, phase diagram between solvating polymer and lithium salt, and the development of new lithium counter-anions. In spite of the progress so far, a highly conductive dry polymer is still not available for use at room temperature. However, effort is continuing, and developers of all-lithium polymer batteries (LPB) presently face a decision if the polymer electrolyte should be heated to enable high-power performance, as required for electric vehicle and energy storage. LPB developers have explored both the high-temperature and low-temperature options.

This presentation discusses the challenges and opportunities in developing lithium ion and thin lithium metal with stable SEI as negative electrodes for three battery technologies:

1. Li-ion batteries containing dry polymer and ionic liquid-polymer electrolytes
2. All solid-state Li-sulfur batteries
3. Li-air batteries.

In addition, we will discuss the safety implications of lithium ion, lithium metal, dendrite mechanism, interface phenomena, side reactions, protection of lithium metal, and lithium alloys.