Mechanical-Activation-Enhanced Surface Functionalization and Capacitance for High-Performance Li Ion Capacitors

Date : **Wednesday, April 6, 2016**

Time : **6:00 pm – 7:00pm**

Location : **Guyon Auditorium**

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Abstract: Lithium-ion capacitors (LICs) have the potential to combine the high energy density of lithium ion batteries and the high power density of supercapacitors into one device. In this study, we have investigated surface functionalization of activated carbon (AC) powder through mechanical activation as cathodes for LICs with non-aqueous electrolytes. Traditionally, surface functionalization is carried out via chemical activation or plasma treatment. Here, we show for the first time that surface functionalization can be achieved with mechanical activation using high-energy ball milling of AC powder in air at room temperature. It is found that mechanical activation is an effective way to create functional groups on the AC surface, thereby imparting pseudocapacitance and increasing the specific capacitance of the AC powder. Although high-energy ball milling has resulted in significant reduction in the specific surface area of the AC powder, the final specific capacitance is in fact increased by 100% because the surface functionalization induced by mechanical activation has drastically increased the areal specific capacitance by ~3,000%. The surface functionalization induced by mechanical activation has been compared with that created by chemical activation. It is found that the pseudocapacitance via chemical activation is mainly due to C=O functional groups, whereas the pseudocapacitance via mechanical activation is derived from both C=O and C-O functional groups. The high specific capacitance obtained from mechanical activation and chemical activation exhibits similar charge/discharge cycle stability as the as-received AC. This work has opened up a new route to increase the specific capacitance of low cost and widely used AC powder for Li-ion capacitors with high cell voltage, large stable electrochemical window, and high energy and power densities simultaneously.