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Advanced *in situ* characterizations of energy materials and devices

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Energy sustainability and environmental protection can both benefit tremendously from energy conversion and storage technologies such as rechargeable batteries, capacitors, and fuel cells. These technologies provide unique opportunities of storing energy harvested from clean and sustainable sources (e.g., solar and wind) and the flexibility of distributing energy on demand. The last few decades have witnessed the fast development in energy storage technologies used for portable electronics and electric vehicles with prospect for large-scale industrial and residential applications. Fundamental research on energy storage materials and devices helps to sustain continuous improvement in performance, cost, and safety. In particular, *in situ* characterization and diagnosis techniques offer the unique capability of connecting chemical, structural, and dynamical changes of various components in the devices with their electrochemical performance in real time. These methods examine the causes for performance degradation and safety issues, and deliver insights in efficient materials design and device fabrication for further performance improvement. Various advanced *in situ* techniques will be discussed in this talk, with a focus on *in situ* solid-state nuclear magnetic resonance and X-ray diffraction studies of rechargeable batteries.

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Green synthesis of gold nanoparticles by natural materials

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Plants (such as tea) and fruits containnatural sources of antioxidants, which can act as reductants and are able reduce gold ions into gold nanoparticles (AuNPs). In this study, a simple and green synthesis of AuNPs has been achieved in tea leaves and fruits with gold ions. Natural antioxidants present in tea leaves and fruits were able to reduce Au3+ ions to make spheres of AuNPs.Different sizes of AuNPs were able to be synthesized with different teas and fruits since they contain a variety of antioxidants. Effect of pH on the formation of AuNPs was also investigated and the morphology of AuNPswas characterized by transmission electron microscopy. Our results indicated that the sizes of AuNPs were dependent on the types of fruits and the $P^{H}S$ of solutions.

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