4th Asia-Pacific Conference on Plasma Physics, 26-31Oct, 2020, Remote e-conference

Sustainable Plasma Chemistry based efficient approach for energy materials

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Most advancing technologies such as communications and data storage, microelectronics, electrochemical energy conversion/transportation/storage require materials and processes which have to meet unprecedented performance characteristics and manufacturing tolerances. The electrode materials, in particular, are the keystone and bottleneck of the ever-expanding market for energy conversion (electrocatalysis) and energy storage (Lithium-ion or Sodium-ion batteries) devices. The exploitation of new materials and modification of existing materials at the atomic level are two prime strategies to increase the performance of energy storage and conversion devices. Most commonly used approach for the fabrication of electrode materials with desirable structures is wet chemical approach which suffers from sluggish reaction rates, and high reaction temperature and long processing/synthesis duration requirements. The innovation in synthesis and processing of new materials with desired structural, morphological, physical and chemical properties is urgently required to achieve improved performance. Low-temperature plasma-chemistry based methods, which provide unique far from equilibrium environment, are fast emerging as an alternative technologies. Such strategy is expected to serve as a promising candidate in the preparation of advanced nanoassemblies for energy storage and conversion materials. The energy storage and conversion electrodes require high performance materials having high efficiency, reliability and stability. The invited talk will focus on use of low temperature nitrogen and carbon plasma in RF-PECVD system to process, dope and synthesize energy storage and conversion materials. The carbon plasmas, from sustainable carbon resource (tea tree oil) instead of using methane, and nitrogen plasmas, from ordinary N_2 gas rather than toxic ammonia, were used to synthesize and process the hybrid porous 3D nanoassemblies of electrode materials. The detailed physical characterization, and performance evaluation of these plasma processed/synthesized nanostructured materials show superior energy storage and conversion performances which will be presented in detail during the talk.

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