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Hierarchical three dimensional Nanostructured assemblies using low temperature plasmas assisted synthesis and processing for Energy Applications

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This invited talk will present the review of various research works that we have recently done on: (i) to develop a simple low temperature plasma based approach for synthesis of free standing 3-D graphene using sustainable tea tree oil as carbon source and their loading by active materials for energy storage; (ii) nitrogen functionalization as well as nano-structurization of metal (Co), mixed metal (NiMo) and commercial carbon cloth by low temperature plasmas to synthesize 3-D porous hierarchical materials, and (iii) application of these nanostructured material for applications in energy storage for lithium ion battery and supercapacitor and also for efficient energy conversion in electrolysis through hydrogen and oxygen evolution reactions (HER and OER). The 3-D vertical graphene (3DVG) templates were synthesized using RF plasma enhanced chemical vapor deposition/processing facility and later loaded with MnO_2 and MoS_2 as active materials using hydrothermal approach to prepare MnO_2@3DVG [1] and MoS_2@3DVG [2] electrodes for supercapacitor and lithium-ion battery assembly. The same setup was used as nitrogen plasma processing facility to create nitrogen functionalized 3-D porous hierarchical nanostructured networks of CoN [3], NiMoN [4] and nitrogen-doped carbon cloth [5]. The detailed physical characterization, and electrochemical and electrocatalytic evaluation of these high porosity three dimensional nanostructured materials demonstrated superior Li-ion storage, supercapacitive and HER and OER electrocatalytic performances.

References

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