Hasi Rani Barai et al., Innov Ener Res 2018, Volume 7
DOI: 10.4172/2576-1463-C2-005

2nd International Conference on
Renewable Energy and Resources
&
Energy Materials and Fuel Cell Research
August 27-28, 2018 | Boston, USA

Nano-structural design of 0D, 1D, 2D, 3D nanoparticles for energy storage devices: Supercapacitor applications

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Nano-structural design for energy storage devices depends on a variety of factors like as structure and properties of the nano-materials. The recent development in nano-structural design has opened up new frontiers by creating new materials and structures for efficient energy storage. In this research, we demonstrated the annealing-free synthesis of K-doped mixed-phase TiO_2 (anatase and rutile, AR) 0D nanoparticles, 1D nanowires, 2D nanosheets, and 3D nanofoams (K-TNF) on Ti foil at 150°C and 250 °C assisted by KOH(aq.)for electrochemical supercapacitors (ESCs). The aggregated network and the average diameter of K-TNF have slightly decreased with the increase of KOH(aq.) concentrations, while the amount of K-doping, Ti^{3+} interstitials, and –OH functional groups was substantially increased. The TiO_2 phase was entirely mixed of rutile and anatase, AR phase. All the K-TNF modified Ti electrodes (K-TNF/Ti) exhibited quasi-rectangular shaped cyclic voltammograms (CVs) in a wide potential range and the specific capacitance (Cs) for the optimal electrode with mixed AR phase TiO_2 obtained. The higher Cs for the optimal K-TNF/Ti electrode can be ascribed to the synergistic effect of mixed AR phase, a high percentage of K-doping (ca.20.20%), and Ti^{3+} interstitials (ca.18.20 %), respectively. The directional electron transport through the 1D channel as well as the –OH functional groups on the K-TNF surface also contributes to enhancing Cs. The K-TNF/Ti electrode discovered excellent stability with the Cs retention of ca. 95% and a very small change of internal series resistance (Rs) and charge transfer resistance (Rct) at the electrode-electrolyte interface after 3000-CD cycles.

Biography

Prof Hasi Rani Barai is the assistant professor in the School of Mechanical and IT Engineering, Yeungnam University, Gyeongsan, Korea, from 2015. She worked as a postdoctoral research fellow in the dept. of Chemistry and Nano science, Ewha Woman's University, Seoul, Korea. She worked as a postdoctoral research fellow in KCAP (Korea center for artificial photosynthesis) in dept. of Chemistry, Sogang University, Seoul, Korea. She received her PhD in the dept. of Chemistry, Inha University, Korea, Master of Science (Physical organic chemistry) and BSc in Chemistry in Dhaka University, Bangladesh. She published about 41scientific journals. She did several invited speaker/oral/poster presentations at national/international conferences. Research interest in nanotechnology, nanomaterial's, materials preprocesses energy storage devices, electrochemistry, and super capacitors.

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