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Bioenergy 2020: In situ development of Ru nanoparticles on N-doped template-free mesoporous carbons for high-performance supercapacitors and dye-sensitized solar cells

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Due to the ever-increasing energy demand, fuel depletion and global climate change, investigation and development of renewable energy conversion and storage devices have increased round the world. Dyesensitized solar cells and supercapacitors are considered clean and environmentally friendly energy conversion and storage devices, thanks to their simple fabrication process and low cost. During this study, in place Ru nanoparticles (Ru-NPs) are prepared on the N-doped template-free mesoporous carbon through the stabilization and carbonization of poly (butyl acrylate)-b-polyacrylonitrile (PBA-b-PAN) block copolymer with Ru (acac)3. Ru-NPs and N-doped porous carbon are formed simultaneously, where PBA-block act as a porous template, while PANblock and Ru (acac)3 acts as semi-graphitic carbon and Ru source, respectively. The resulting Ru-NPs on N-doped mesoporous carbon shows a really high specific gravimetric capacitance of 656.25 F g−1 at a scan rate of 10 mV s−1, good rate capability, and excellent long-term cycling stability (almost 100% retention after 5000 cycles) when applied because the electrode in supercapacitors. Furthermore, it shows excellent catalytic activity toward the cobalt reduction reaction in DSSC, and optical transmittance properties within the visible wavelength (AVT, 42.25%). When Ru-NPs on N-doped mesoporous carbon were employed as CEs during a bifacial DSSC using SGT-021 sensitizer, an interesting power conversion efficiency of 10.13 % and 8.64% from the front and rear illumination, respectively, were obtained. Also, a typical DSSC with the resulting CEs shows a PCE of 11.42%.

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