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Modification of carbon coatings structure by treatment in C2H2 DC plasma

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The carbon films were deposited on steel substrates by plasma jet chemical vapor deposition (PJCVD. The torch power was 840 W, Ar/C_2H_2 gas ratio - 55, the distance between the anode nozzle exit and the substrate - 5mm, deposition time - 150s. The magnetron sputtering method was used for surface modification of the carbon coatings. The etching of the films was done in C_2H_2 plasma at ~1 Pa pressure by changing the modification time from 1 min to 5 min. The surface morphology was characterized by scanning electron microscopy (SEM) model JEOL JSM–5600. The energy-dispersive spectrometry (EDS, Bruker AXS Microanalysis GmbH) analysis was used to determine the elemental composition of carbon electrodes. The bonding structure was characterized using X-ray diffraction (XRD) measurements and Raman scattering (RS) spectroscopy. Aqueous solution (dilute KOH electrolyte 40 %) was used as the electrolyte. A separator was used to keep the electrodes from contacting each other.The electric characteristics of fabricated supercapacitors were measured using standard electrical circuit at 150 μA. The SEM study shows that the surface porosity of carbon films decreases with the increase of the modification time. The XRD analysis indicated the amorphous structure of the carbon films. RS investigations demonstrated that increase of etching time increases the fraction of the sp^2 C=C sites in the films. The EDS investigations revealed that the relative quantity of oxygen decreases from ~17.0 at.% down to 4.0 at.% with the increase of interaction time from 1 min to 5 min. The supercapacitors prepared from the modified carbon electrodes demonstrated higher capacity values. The capacity values increases from 3 mF up to 60 mF after 5 min treatment in C_2H_2 plasma.

Keywords
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