Improving Fresh and End-Used Carbon Surface by Sunlight a Step Forward in Sustainable Carbon Processing

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ABSTRACT

Carbon is at the forefront of sustainable materials; the modification of its surface is pivotal to many traditional and advanced applications. Conventional high-temperature activation or chemical etching for carbon surface modification is time- and energy-intensive as well as requiring a high volume of toxic chemicals; therefore, a cheaper, quicker, and eco-friendly technique is a step forward toward its sustainable processing. Herein, modification of fresh and end-used carbon surface through focusing the sunlight is demonstrated as a clean, sustainable, and instantaneous surface modification technique for electrochemical charge storage application. Temporal evolution of the carbon surface is monitored using field-emission scanning electron microscopy, gas adsorption measurements, Fourier transform infrared spectroscopy, and X-ray photoelectron spectroscopy. Results demonstrate that solar irradiation led to the rapid release of moisture, which in turn generated newer pores. Electrochemical analyses showed that treating the porous carbon for 20 s boosted its electrical double layer capacitance by 56%. The usefulness of the solar treatment in recovering degraded electrochemical capacitor electrodes was also investigated, where 95% of the electrochemical performance was restored. This work demonstrated the feasibility of utilizing focused sunlight for surface treatment, suggesting utilizing sunlight for a sustainable, activation agent-free, and rapid surface treatment technique.

KEYWORDS

activated carbon; surface modification; porosity; supercapacitor; sustainability; recycling; recovering

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