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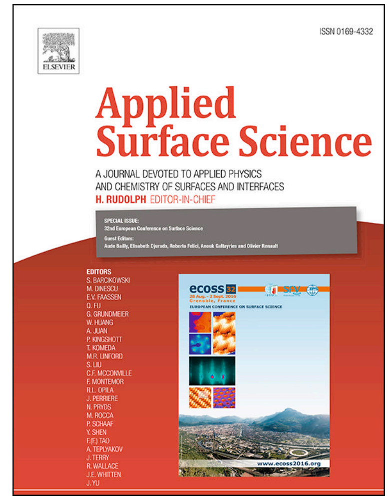

Full Length Article

Graphitized Hierarchically Porous Carbon Nanosheets Derived from Bakelite Induced by High-repetition Picosecond Laser

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ACCEPTED MANUSCRIPT

Graphitized Hierarchically Porous Carbon Nanosheets Derived from Bakelite Induced by High-repetition Picosecond Laser

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Abstract: Development of rapid processes combining the preparation of porous structures with the control of their properties has remained a challenge. This is particularly true for applications of graphitized hierarchically porous carbon nanosheets (GHPCNs) predominantly focus on fields of energy storage and conversion materials, electronics, sensors, separation and detection. Here we report an one-step approach to transform commercial bakelite into three-dimensional high electrical conductivity GHPCNs using the high-repetition picosecond infrared laser scribing in nitrogen atmosphere. The GHPCNs with mesopores and macropores can be rapidly induced on bakelite plate by the transient laser heating due to thermal accumulation effect. Studies reveal that the in-plane topological defects of the bakelite-based GHPCNs flakes contain pentagon-heptagon structures. The local controllable laser patterning technique enables porous structures and shapes to be controlled in highly GHPCNs films with variable properties. The methodology developed here have great potential to stimulate both research and industrial interest in the development of bakelite-derived GHPCNs electronic and energy storage micro-devices.

Key words: GHPCNs; Bakelite; Picosecond laser; Intrinsic defects; Ablation threshold; Applications

1. Introduction

In the last decade, 3D graphitized hierarchically porous carbon nanosheets (GHPCNs) including porous graphene, have been attracting considerable interest due to their wide applications such as in catalysis, flexible electronics, energy conversion and storage, and membrane filtration **[1-9]**. In addition, the porous structures, pore size distribution and physicochemical properties of the GHPCNs can be controlled by the selection of carbon precursors, synthesis methods and conditions. Recently, the GHPCNs have been synthesized by the pyrolysis of various carbon precursors, such as polymer and biomass, using heat sources such as high temperature **[10-12]** and lasers **[13-17]**. High temperature treatment is a traditional method, which usually requires higher temperatures to form well-developed graphitic structures. Apparently, high temperature graphitization method is a time-consuming and high-energy consumption process with low yield and poor porosity. Furthermore, the post-treatments require a large amounts of corrosive liquids for etching and activating, which is a tedious stepwise processes. These conditions represent unfavorable disadvantages for the production of GHPCNs

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