Laser processing of SiC: From graphene-coated SiC particles to 3D graphene fronds

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We explore the feasibility of laser-assisted graphitization of micron sized SiC particles.
It is demonstrated that laser-mediated SiC decomposition, at nearly ambient conditions, can result in a manifold of graphene structures e.g. SiC particles covered by few-layer epitaxial graphene up to highly porous graphene-like structures (froth morphology).
SiC particles coated by few-layer graphene films are considered for applications in macro- and nano-electromechanical systems owing to their very high electrical conductivity.
The enhanced mechanical properties of graphene-coated SiC particles may be suitable for body armor applications.

Advantages of Lasers in Graphene production
Fast
Cost-effective
Adaptable
Scalable
Eco-Friendly
Innovative

Laser-Assisted Graphene Growth and Processing

Graphene Growth
• Epitaxial on SiC
• Ablation of Graphite
• Decomposition of Organic Films
• Laser Exfoliation in Liquids
• Heat source for CVD growth

Graphene Processing
• GO Reduction to Graphene
• Laser Thinning of Multilayer Graphene

Experimental

Graphitization of 20 μm SiC particles
Field Emission Scanning Electron Microscopy

Results

Concluding Remarks

The results presented here demonstrate that depending on the SiC particle size and irradiation details, graphitization can take place under various morphologies
Laser-induced graphitization is evidently a versatile and adaptable technique for the preparation of carbide-derived carbons from inorganic precursors
Scalability of laser-assisted graphitized SiC particles production to large scale appears realistic in view of the high rate of laser processing (short time decomposition)

Motivation

Typical FE-SEM images of laser-processed SiC particles (20 μm). From (a) to (h) images correspond to structures subjected to progressively higher dose.

HRTEM and Raman Spectroscopy studies

Graphitization of 2 μm SiC particles
Field Emission Scanning Electron Microscopy

Raman Spectroscopy study

More details can be found in: A. Antonelos, V. Dracopoulos and S. N. Yannopoulos, Carbon 85, 176-184 (2015).

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