Metal-Carbon Nanohybrid Foams: from Laser Chemistry to Nanochemistry

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Abstract

Metal-carbon nanohybrid foams have been produced by laser irradiation of organometallic precursors.[1] The laser irradiation of aromatic organometallic precursors resulted in milligram quantities of soot exhibiting a fibrous appearance. Scanning electron microscopy (SEM) characterization showed that the microstructure of this material exhibited the porous, foam-like texture which results from the aggregation of ‘‘necklace’’-like ensembles of nanobeads, similar to that observed in other ‘‘spongy’’ carbon materials, such as carbon aerogels [2,3] and carbon nanofoam [4]. Transmission electron microscopy (TEM) studies reveals that these metal-carbon nanohybrids are multi-component materials that consist of metal nanoparticles embedded in amorphous carbon aggregates, amorphous carbon nanoparticles, and graphitic nanostructures, which can be eventually observed as independent, separate components in the produced soots (Fig. 1). [5]

The present work also reports on important experimental parameters toward the controlled synthesis of these carbon foams. Thus, characterization studies indicate that the composition, metal nanoparticle dilution and crystallite size, and structure of the metal-carbon foams can be tailored by suitably tuning the laser parameters used and by choosing the metals and ligands of the irradiated targets.[5,6] It is also demonstrated here that, contrary to carbon aerogels, the employed metals are not required for the growth of the observed graphitic nanostructures.[2,3,5]

This “laser chemistry”, based on the use of molecular precursors, would enable the facile production of multifunctional nanostructured carbon materials with a range of tunable properties. Alternatively to this “laser chemistry” approach, wet chemistry strategies have been designed for the synthesis of metal-carbon nanohybrids based on the in-situ reduction of noble-metal salts in presence of carbon foams produced by laser ablation of metal-free organic compounds. Further physical-chemical characterization studies, chemical processing, and potential technological applications of these metal-carbon nanohybrid foams will be also discussed.[6]

References

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Figures

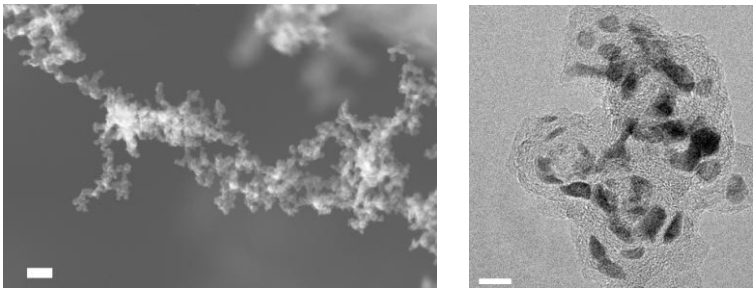

Fig. 1. SEM-(left, scale bar: 100 nm) and TEM (right, scale bar: 10 nm) micrographs of laser-ablation produced Au-carbon foams [1].