CiQUS Lecture

Laser induced transformations of molecular solids into nanostructures

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Abstract

Lasers are used in multiple industrial applications to process all sorts of materials. Cutting or welding thick steel or other metal sheets, ceramics and polymers are widely used in the industry, but not the only relevant applications developed with laser technology. In fact, there are innumerable lasers employed all over the world within industrial processes ranging from the metallurgy, through the electronics and even the textile industries. Such a wide variety of applications, based on laser's excellent spatial and temporal resolution, suggests an unparalleled potential for the development of novel, selective synthetic processes. Their use for the fabrication of nanomaterials at the large scale is still, however, an important challenge. A large number of papers have reported on the preparation of C nanotubes, nanostructures and metal nanoparticles during the last several decades, starting from either graphite [1] or molecular precursor [2-4] targets. Irradiation with different lasers enables control of phenomena triggering the transformation of extended C solids and molecular precursors into the desired nanomaterials. For example, cw CO_2 lasers emitting in the mid-IR (10.6 µm) are useful to obtain single-wall C nanotubes from graphite targets. Near-IR emission, such as that obtained from Nd:YAG, Nd:YVO_4 or Yb:fiber lasers is useful to obtain hybrid nanostructures from molecular precursors, either in cw or pulsed working mode. This talk will briefly review the basis of laser-matter interactions through a more detailed analysis of examples selected from the above transformations. It will also attempt to assess the potential implementation of lasers towards the controlled fabrication of nanostructures.

1. W. Maser et al., Chem. Phys. Lett. 292 (1998) 587-593.

2. E. Muñoz et al., Chem. Phys. Lett. 420 (2006) 86-89.

3. M. A. García et al., Chem. Mater. 19 (2007) 889-893.

4. A. Seral-Ascaso et al., Nanoscale Research Letters 8:233 (2013).