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A fiber-based bunch of flowers

Carbon fibers in an aluminium sheet

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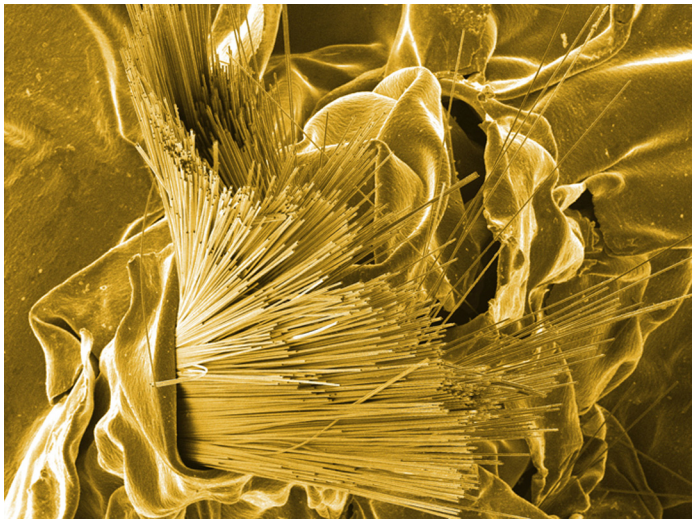

If one examines the rich family of carbon materials, having grown over the last two decades with the explosion of interest in nanoscale carbons, it is evident that some members of the family have reached maturity. By which we mean, we know all about preparation, the properties and have explored all the practical applications for them. But is this really true?

There are some classes of carbon materials, that have been successfully used for decades in many technological fields, which are no longer stimulating strong scientific interest or raising expectations for future development. This is the case of two interesting classes of C materials; namely glassy carbon and carbon fibers, that have an edge over other materials for a variety of uses, but are presently not very attractive to researchers.

Nowadays the fashion of the ''nano'' is taking much of the attention of the scientific community and absorbing most of the activities of research groups active in the fields of materials science and technology. In our labs the main research work is also focused on nanomaterials, in particular on the burgeoning class of carbon nanomaterials, such as nanotubes, onions, nanographites, dendrimers and nanodiamonds. Great attention is paid to the development of synthesis techniques for the production of nanocarbon systems with controlled chemical state and architecture of the deposits. The preparation of C nanostructures coupled with polymers and nanometals also represents a fundamental task of our research.

In particular, hybrid materials constituted by sp^2-sp^3 C and Si nanostructures have been successfully grown using chemical vapor deposition techniques [1,2]. By adopting chemical and/or electrochemical synthetic approaches, inorganic-organic nanocomposites have been synthesized where the guest nanocarbon inclusions not only behave as fillers able to improve the functional properties of the base material, but act toward modifying the structural organization of the host polymer matrix [3–5]. Moreover, the modification of carbon nanotubes and nanodiamonds with metal nanoparticles (Ni, Au) has led to the development of complex systems for advanced applications in fields ranging from electronics, sensing, optics and biomedicine [6–10].

However, despite all the stimulating results provided by the innovative C nanomaterials, we are aware of the fact that some ''old'' components of the carbon family, such as the cited glassy carbon and carbon fibers, still have a lot to give. In this context we thought it worthwhile to carry out, in parallel with research activities on a variety of exciting nanocarbons, studies on more traditional carbon materials.

Aiming to explore new opportunities that could be offered by carbon fibers, we are submitting commercial samples to a series of chemical and physical treatments. The objectives are to modify the

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external skin of the fibers, to enhance their surface/volume ratio, to modify their structure, to introduce functionalizations, to coat the fibers by polymers or metal layers, to improve their electrode activity, to modulate the mechanical and electrical properties, to enhance the sensing activity, and more.

The cover image of this issue refers precisely to a study carried out in the frame of this research and depicts a bunch of C fibers wrapped inside a thin Al sheet. This strange but beautiful arrangement has been obtained during an attempt to compact a sample of treated fibers for electron microscopy observation. At the bottom, the fibers appear connected in a kind of rope due to the clamping by the Al sheet, but, out from the grasp of the metal, the individual fibers branch out. As one can see, the fan-like arrangement of the fibers is gently supported by the wavy Al sheet, that looks like the wrapping paper around a bunch of flowers. This arrangement constitutes one of the stages of an innovative approach we are currently investigating for the fabrication of C fiber-based systems as reliable binder-free electrodes for hybrid supercapacitors. Such devices are at the forefront in the development of novel energy storage/conversion systems, and we believe that C fibers-based materials can still play a key role in the production of energy storage devices with an easy manipulation and long-term stability.

Further reading

[1] M.L. Terranova, et al. Chem. Mater. 17 (12) (2005) 3214–3220.
[2] S. Orlanducci, et al. Cryst. Growth Des. 12 (9) (2012) 4473–4478.
[3] D. Sordi, et al. Carbon 49 (7) (2011) 2227–2234.
[4] E. Tamburri, et al. Polymer 53 (19) (2012) 4045–4053.
[5] E. Tamburri, et al. J. Mater. Chem. C 2 (19) (2014) 3703–3716.
[6] E. Tamburri, et al. J. Nanopart. Res. 11 (6) (2009) 1311–1319.
[7] S. Orlanducci, et al. J. Nanosci. Nanotechnol. 11 (6) (2011) 4882–4887.
[8] S. Orlanducci, et al. Chem. Phys. Lett. 549 (2012) 51–57.
[9] A. Gismondi, et al. Biomaterials 38 (2015) 22–35.
[10] E. Tamburri, et al. Electrochim. Acta 157 (2015) 115–124.