

Making paper and polyurethane foams smart, for advanced applications

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Nowadays, low-cost materials and easily reproducible techniques for the fabrication of functional materials have received much attention. We present two methods based in the use of nanocomposites, that render natural and synthetic materials of the everyday life such as paper and polyurethane foams multifunctional. In the case of paper we render its cellulose networks multifunctional, by impregnating the individual fibers with a reactive acrylic monomer solution mixed with nanoparticles of desired functionality. When the monomer contacts the cellulose, the topochemical polymerization is taking place, resulting in the formation of a thin nanocomposite shell around each fiber, where nanoparticles are trapped. Thus, the treated paper obtains the functionality of the nanoparticles used, it becomes humidity and mechanical resistant, while the overall morphology of the sheets does not change. The functional paper can be used for the fabrication of low-cost scientific devices, or for everyday-life applications (e.g. packaging). Concerning the polyurethane foam, used in packaging, furniture construction etc., we are able to make it magnetic and self-cleaning and we propose its use for the water-oil separation. Specifically, the polyurethane foam is the substrate on which a small amount of iron oxide nanoparticles solution is casted, and a subsequent triboelectric deposition of PTFE particles is performed. Such functionalization makes the foam oil-absorbing, water-repelling and magnetic. Therefore, the foam floats on water and can be magnetically driven towards the oil spill which can efficiently absorb, purifying thus the water. Indeed the capacity of the foam is 13 times its weight and it can be used in sea, acidic or basic water while absorbs oil of various viscosities.

Biography

Despina Fragouli is currently a Team Leader at the Smart Materials Group of the Italian Institute of Technology (IIT). She graduated in 2001 in Physics at the University of Crete-Greece. She has an MSc in Applied Molecular Spectroscopy, and a Ph.D., from the Chemistry Department, University of Crete, in collaboration with the Foundation of Research and Technology, (IESL-FORTH) Greece. On 2007 she became a postdoctoral fellow at National Nanotechnology Laboratory in Lecce, Italy. On 2009-2011 she was a senior postdoctoral at the Smart Materials Platform of the Center for Biomolecular Nanotechnologies of IIT. Her main interests are the fabrication and characterization of smart and responsive materials, and she has published more than 25 papers in reputed journals.

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