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Nanochemistry – The Big Promise of The "Smalls"

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In the year when the scientific community is celebrating the Year of Chemistry, we are looking to the evolution of this domain in the last century, resulting in tremendous successes and not negligible mistakes.

Considering the most important breakthroughs in the chemistry, one could not miss the particularly important role played by nanochemistry. This emerging new field is part of the nanoscience, the multidisciplinary domain that includes the study of the matter structured at the nanometric scale.

This special role of nanochemistry rises from the importance of the down-up approach for both the synthesis of nana-sized materials and understanding of the size-dependent chemical and physical properties of nanomaterials. It is nanochemistry that offers endless possibilities for the preparation of new nanostructured materials and to control their size and shape, which are major tools for nanoscientists and anaotechnologists to produce advanced devices and products for the future.

The development of the nanochemistry led in the two last decades to a rapid progress in obtaining and characterization of various nanomaterials with a wide are of applications: medicine, energy storage, environment protection, defense, transportation, food quality, information technology, etc. Based on nanochemistry, materials that are stronger, lighter, more durable, more reactive, with better thermal or electrical properties can effectively be made.

We must remember that nanochemistry does not remains only a big promise, there already exist over 800 commercial products that contains at least one nanoscale- structured material, such as: polymer composite materials with nanostructures additives for baseball bats, tennis rackets and automobile bumpers, materials for surface treatments of fabrics with anti-wrinkiling, anti-staining and antibacterial properties, nanostructures surfaces that are water-repellent, antireflective, self-cleaning, antifog, and scratch-resistant, modern sunscreens, creams, shampoos, and specialized makeup for cosmetic, nanocomposites in the food industry for food packaging or nanosensors to detect salmonella, pesticides, and other contaminates, nanostructured multifunctional materials to produce high-power rechargeable battery systems for electric automobiles, nanoparticles based composites as films for solar panels with high conversion energy factor, nanoparticles for catalysis used to boost

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chemical reactions in petroleum refining, nanostructured polymer films for organic light-emitting diodes (OLEDs) for the production of displays for the new TVs, laptop computers, cell phones, digital cameras, and other electronic devices.

Despite the huge development, nanotechnology is far to consume its entire potential of applications. New products, methodologies and techniques are expected in the near future for medicine and biology, all of them based on nanochemistry achievements. Some examples of important advances in these areas are the new methods proposed for bioimaging, based on biocompatible quantum dots (semiconducting nanocrystals with suitable functionalization), that exhibit exceptional photphysical properties, new multifunctional nanoparticles used in the early diagnosis of cancer, atherosclerosis, gold nanoparticles used to detect early-stage Alzheimer's disease. New pharmaceutical formulation to provide modern therapy, for controlled drug delivery and specific targeting are currently under clinical evaluation, such as oral formulations for insulin and chemotherapeutics for cancer treatment based on lipsomes, microemulsions or nanoparticles.

Beyond of many beneficial aspects of the products based on nanomaterials on the quality of many aspects of our lives, it is mandatory to take into account that these compounds could be harmful to the environment and humans. As physical and chemicals properties of the materials structured at nanometric scale are very different from the bulk, depending on the size and surface area, beyond the chemical composition, and they can influence the reactivity towards biomolecular targets, the toxicity of nanomaterials is an important issue in the sustainable development of the domain of nanotechnology.

Since it is not possible to provide here the whole image of the nanochemsitry, I hope the reader will find this paper as an impulsion to a reflection on the role of nanochemistry in the field of chemistry of the new millennium.