

RADIATION ENGINEERED MULTI-FUNCTIONAL NANOGELS AS NANOSCALE BUILDING BLOCKS OF USEFUL BIOMEDICAL DEVICES

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Nanogels, or small particles formed by physically or chemically crosslinked polymer networks, represent a niche in the development of “smart” nanoparticles for drug delivery and diagnostics. They offer unique advantages over other systems, including a large and flexible surface for multivalent bio-conjugation; an internal 3D aqueous environment for incorporation and protection of (bio)molecular drugs; the possibility to entrap active metal or mineral cores for imaging or phototherapeutic purposes; stimuli-responsiveness to achieve temporal and/or site control of the release function and biocompatibility. Moreover, conformability and flexibility make these nanoparticles able to penetrate through small pores and channels through shape modification. Major synthetic strategies for the preparation of nanogels belong to either micro-fabrication methodologies (photolithography, microfluidic, micromoulding) or to self-assembly approaches that exploit ionic, hydrophobic or covalent interactions. When dimensional control has been achieved through the recourse to “soft templates”, such as the internal aqueous phase droplets of inverse microemulsions, the use of surfactants, initiators and catalysts often require complex purification procedures. On the other hand, micro-fabrication methods, such as nanomoulding, are limited by the need of costly equipments. The availability of inexpensive and robust preparation methodologies is at the basis of the development of effective nanogel-based theragnostic devices.

High energy radiation processing already demonstrated its potential for the production of nanogels in the late ‘90s, owing to the pioneeristic work of Rosiak and collaborators, but since no adequate efforts have been spent in developing a viable and robust technology to produce multi-functional nanogels for the benefit of several different nanotechnology application fields, such as sensing, medicine and multiple others. The design rules for mass fabrication of nanoscale hydrogel particles with the recourse to industrial-type accelerators will be discussed. Radiation engineered nanogels may become base building blocks of higher order structures with designed properties, through the integration of heterogeneous components of different sizes and compositions, including biomolecules.