OXIDATION-SENSITIVE NANOPARTICLES FOR CONTROLLED RELEASE APPLICATIONS

A. Rehor*, M. Valentini*§, J.A. Hubbell*, N. Tirelli*§
§ School of Pharmacy, University of Manchester, M13 9PL Manchester, United Kingdom
* Institute of Biomedical Engineering, Dept. of Materials, ETH Zürich, 8044 Zurich, Switzerland

The recently discovered anionic polymerization of episulfides in water emulsion allows the preparation of hydrophobic nanoparticles made of well-defined polymer chains, characterized by low dispersity in MW and presence of functional groups at the chain ends (thiols). By the use of multifunctional initiators, star polymers can be obtained and then cured, exploiting the reactivity of the terminal thiol groups (disulfide formation, Michael-type addition). The resulting nanoparticles are thus cross-linked (overcoming problems of coagulation of the rubbery colloidal matter) and characterized by an homogeneous mesh-size. A PGSE-NMR study has revealed that the emulsifier used during the polymerization (Pluronics F127) remains irreversibly adsorbed on the particle surface, which thus displays protein-repellent poly(ethylene glycol) (PEG) blocks. The protein-repellent ("stealth") character of the nanoparticles is the first and essential requirement for a long circulation time in body fluids. Upon exposure to oxidative environment, the hydrophobic polysulfide chains are converted in hydrophilic polysulfoxides or polysulfones, determining a swelling of the nanoparticles structure. Correspondingly, any hydrophobic compound encapsulated during the polymerization procedure is released. Perspective applications are envisaged in the treatment of inflammatory conditions, which often feature strongly oxidizing environment and whose symptoms are relieved by the use hydrophobic anti-inflammatory drugs.