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Our World of ATRP

From surfaces over fluorinated copolymers to gold nanoparticles and biologically active miktoarm stars

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The presentation will be a journey through the last decade illuminating our activities in the World of atom transfer radical polymerization (ATRP). Since the early start where we established the ATRP potential^{1,2} of pentafluorostyrene (FS) we have extensively exploited the advantages of this controlled polymerization technique in the development of a multitude of different polymer materials responsive to various external stimuli the so-called smart polymer materials. All of the basic advantages of ATRP: polymerization of functional monomers and control of polymer chain structure, end-groups, reactivity, molecular weight and the relatively narrow polydispersity have been exploited to prepare block and star copolymers and employ surface-initiated polymerization. In addition, multifunctional initiators and macroinitiators based on both commercially available and in-house prepared polymers as well as macromonomers have been utilized.

The continued tour will elucidate the application of FS as the workhorse for development of low energy surface materials,³ triblock copolymers intended as electrolytes for Li⁺ batteries,⁴ nearly insoluble fluorinated nanoparticles,⁵ and fluorinated copolymers with pendant sulfonates intended for hydrogen fuel cells.⁶ The applicability of ATRP was later additionally extended to prepare (co)polymers from fluorinated and other functional methacrylates.⁷⁻¹⁰ In our hands also azobenzene containing block copolymethacrylates have shown a promising potential for volume holographic optical storage.¹¹⁻¹⁴ The star concept has also been employed in the preparation of amphiphilic model block copolymers for rheological investigations.^{15,16} The attractive surface-initiated ATRP concept has been exploited by grafting styrene from cellulose,¹⁷ and more recently used to create biofunctional surfaces¹⁸ e.g. PPEGMA on PEEK¹⁹ and PP able to repel a protein such as insulin aspart^{B28}. Most recently novel bionanomaterials have been prepared by combination of ring opening polymerization (ROP) and ATRP resulting in cancer therapeutic gold nanoparticles.²⁰ In addition, a combination of “click chemistry” and ATRP furnished miktoarm core crosslinked stars with the biologically active moieties, estradiol and L-lysine, on the surface.²¹

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