

NANO-HYBRID HYDROGELS: STRUCTURE/PROPERTIES RELATIONSHIPS

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ABSTRACT

Hybrid self-assemblies based on the adsorption process of poly(*N,N*-dimethylacrylamide) [PDMA], poly(*N*-isopropylacrylamide) [PNIPA] or poly(ethylene oxide) [PEO] with silica nanoparticles are reported. From adsorption isotherms and calorimetric experiments, it is shown that *N*-alkylacrylamide derivatives strongly interact with silica surfaces while PEO chains exhibit lower affinity. When such oligomers are grafted onto a non-adsorbing poly(acrylamide-co-sodium acrylate) backbone [PAMH], the binding process of these adsorbing side-chains with silica nanoparticles proceeds very similarly and gives rise to the formation of hybrid hydrogels as sketched in **Figure 1** below.

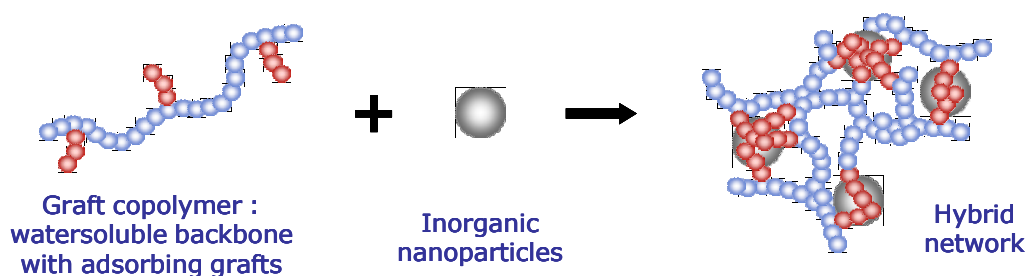


Figure 1: Schematic representation of hybrid self-assemblies between adsorbing grafts and silica particles.

The viscoelastic properties of these networks are controlled by the concentration of inorganic cross-links and the fraction of adsorbing grafts involved in the formation of bridges between particles. For all hybrid formulations investigated, an optimum weight ratio between silica and grafts was found for the viscoelastic properties, in agreement with the saturation of silica beads by the graft precursors. Due to the temperature dependence of the solubility of PNIPA side-chains in aqueous solutions, the PAMH-g-PNIPA copolymer is also able to self-assemble with temperature, giving rise to a hybrid co-network in the presence of added silica¹⁻³.

While the formulation of these hierarchical hybrid assemblies remains limited to mixtures involving low polymer concentrations (≤ 2 wt%), we show that homogeneous hybrid networks can be prepared by direct polymerization of DMA monomer in the suspension of silica nanoparticles. In this case, the specific interactions taking place between the silica filler and the polymer matrix, as well as the self-crosslinking of PDMA chains arising during radical polymerization, give rise to highly deformable tough hydrogels with enhanced mechanical properties⁴.

References:

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