

## Polymer ligand stabilized nanoparticles: From adsorption kinetics to tunable aspect ratio particles

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Ligand exchange with end-functionalized polymer ligands is an important strategy to increase the colloidal stability of inorganic nanoparticles, render these compatible with different solvents/matrices and to increase functionality of the system.<sup>1</sup> The properties of such ligand-stabilized particles depend strongly on grafting density, molecular weight and chemical composition of the ligand as well as on the homogeneity of the ligand shell.

We used spherical gold nanoparticles as convenient model particles to study the ligand exchange with different ligand systems, namely end-functionalized polystyrene (PS) and poly-*N*-isopropylacrylamide (PNIPAM) of different molecular weights and weight distributions. For the ligand exchange with PS and the phase transfer to organic solvents, we developed an exchange protocol that uses an intermediate transfer step with an auxiliary ligand.<sup>2</sup> Grafting densities were determined by a combination of scattering techniques and ultracentrifugation. In that system, the ligand shell thickness (or brush height) scales in the concentrated polymer brush (CPB) regime for highly stretched chains. We have also shown how the adsorption kinetics during the ligand binding process can be followed in situ using fluorescence spectroscopy with fluorescently labeled polymer ligands. Extending our studies towards PNIPAM ligands, we could prepare nanoparticle systems with ligand shells that possess LCST-type phase behavior. In that case, colloidal stability can be altered by simple changes in temperature.<sup>1</sup> The functionalization of anisotropic gold nanorods with PNIPAM ligands led to a system where the aspect ratio becomes controllable by temperature.<sup>4</sup> We studied this via the changes in rotational and translational diffusion using depolarized dynamic light scattering.

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