Model Reaction studied on Faceted Gold Nanoparticles

Stefanie Wunder1*, Yan Lu1, Martin Albrecht2 and Matthias Ballauff1

1 Soft Matter and Functional Materials, Helmholtz-Zentrum Berlin für Materialien und Energie, Hahn-Meitner-Platz 1, 14109 Berlin, Germany
2 Leibniz-Institut für Kristallzüchtung (IKZ), Max-Born-Straße 2, 12489 Berlin, Germany
* e-mail: Stefanie.Wunder@helmholtz-berlin.de

Metallic Nanoparticles (NP) show interesting properties in comparison to the bulk-material. In our studies we synthesized metallic NP (e.g. Au, Pd, Pt, or nanoalloys) by using spherical polyelectrolyte brush particles (SPB) as carrier systems [1] to avoid agglomeration. SPBs consist of a core of polystyrene, onto which cationic polyelectrolyte brushes are grafted [2]. As can be seen in figure 1 the nanoparticles are quite well defined.

In a recent study, the catalytic reduction of 4-nitrophenol (Nip) with sodium borohydride (BH4¯) as reducing agent has been studied in detail [3]. The reaction was analyzed by UV-vis spectroscopy and a detailed kinetic analysis was made. It could be shown that the reaction follows a Langmuir-Hinshelwood-type kinetic. The intrinsic rate constant and the adsorption constants for the Nip and BH4¯ could be determined.

Recently the temperature dependence of intrinsic rate constants and the adsorption constants have been analyzed to obtain the activation energy of the intrinsic rate constant, the enthalpy and the entropy of the adsorption constants of Nip and BH4¯ [4]. Furthermore, in many cases an induction period (t0) is visible, before the reaction starts. The induction period is dependent strongly on the concentration of Nip but not on the concentration of BH4¯ (figure 2). This induction period was found to be not due to diffusion of the educts through the polymeric layer, but a result of surface reconstruction [4].