SYNTHESIS AND CHARACTERIZATION OF FUNCTIONALIZED NANOPARTICLES AND THEIR USE IN NANOCOMPOSITES WITH TAILORED PROPERTIES

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Nanostructured organic–inorganic hybrid systems represent an exciting class of materials. Polymers reinforced with nanoscale particles should show vastly improved properties. Yet, experimental evidence suggests that a simple extrapolation of the design paradigms of conventional composites cannot be used to predict the behavior of nanocomposites. A major problem arises from the fact that the control of the mixing between the two dissimilar phases remains a challenging task, and there still is a lack of data on structure–property relationships at a nanoscale level. We have thus started a systematic study in which we combine synthetic activities for the production of nanoparticles with functionalized surfaces and tailored properties with the application of state-of-the-art characterization methods such as time-resolved neutron and X-ray scattering experiments in order to understand and improve the formation mechanism of polymer-colloid nanocomposites [1].
In this presentation, I will give an overview of the different types of particles and particle architectures such as composite core/shell particles, particles with tuneable optical and magnetic properties and specific surface functionalities that can be obtained using a wet chemistry approach [2-3].
I will show how we can control the particle morphology (poly- versus monocrystalline), their size and shape as well as their size distribution and their stability against aggregation and phase separation if we possess knowledge about the growth mechanisms and the interparticle interactions. As an example, I will present how particles can be transferred from aqueous to organic media (or vice-versa) through appropriate surface functionalization without having to go through a drying step, and demonstrate how this can be used to integrate them into a polymer matrix in order to make new nanocomposite materials. Some strategies to modify the surface chemistry of colloidal particles will be also presented.

References:

[1] Saric M. et al., Colloids Surf. A, **291** (2006) 110.
[2] Dietsch et al. Chimia, **62** (2008) 805.
[3] Mohanty et al., Langmuir, **25** (2009) 1940.