Functional nanocomposites and organic thin films - from gas phase synthesis to applications

Talks by: Stefan Schröder, Alexander Vahl, Salih Veziroglu
and Prof. Dr. Franz Faupel

*Chair for Multicomponent Materials, Faculty of Engineering, Kiel University, Kaiserstr. 2, 24143 Kiel, Germany, *ff@tf.uni-kiel.de*

Nanocomposite films consisting of metallic nanoparticles embedded in a dielectric matrix have unique functional properties with hosts of applications. Particularly attractive are highly filled nanocomposites close to the percolation threshold. Here, control of the particle separation on the nm scale is essential because the functional properties often require short-range interaction between nanoparticles.

Our group mostly employs vapor phase deposition, which is a scalable approach permitting excellent control of the metallic filling factor and its depth profile as well as the incorporation of alloy nanoparticles with well-defined composition. Concerning alloy nanoparticles, deviation from the equilibrium phase diagrams have to be considered.

We applied various methods such as sputtering, evaporation, and plasma polymerization for the deposition of the dielectric matrix. For polymer films, initiated chemical vapor deposition (iCVD) also turned out to be a versatile technique for the deposition without destruction of the functional groups. Recent examples of organic thin films synthesized by iCVD include highly stable electrets for electret microphones and magnetoelectric sensors, 3D superhydrophobic coatings, and nanoscale gradient copolymer films for various applications.

In our earlier work on nanocomposites, the metallic component was mostly co-sputtered or co-evaporated, and the nanoparticles formed in the growing matrix by self-organization. Recently, we put emphasis on generation of the nanoparticles by means of high-rate gas aggregation cluster sources to obtain independent control of filling factor and size of the embedded nanoparticles.

Formation of plasmonic nanoparticles can be monitored in situ via UV-vis spectroscopy. We also demonstrated *in situ* control of the composition of alloy nanoparticles and the ability to fabricate multiple core-shell particles. More recent examples of fabricated nanocomposites range from plasmonic meta-materials through photo-switchable devices to memristors and memsensors for neuromorphic electronics. Moreover, we developed new process for photocatalytic growth of metallic nanostructures.

28 October, 12.45 – 13.45, online via Zoom
Link to Zoom seminar: **https://syddanskuni.zoom.us/j/64976225222**