Universität Bielefeld **Fakultät für Physik**

Physikalisches Kolloquium

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Functional Nanocomposites – From Fabrication to Function

Highly filled particulate nanocomposite films consisting of metal nanoparticles in a dielectric organic or ceramic matrix have unique functional properties with hosts of applications. In most applications, a high filling factor close to the percolation threshold with control of the particle separation on the nm scale is essential because the functional properties often require short-range interaction between nanoparticles. The present talk demonstrates how vapor phase deposition techniques can be employed for tailoring the nanostructure and the resulting properties. Vapor phase deposition, inter alia, allows excellent control of the metallic filling factor and its depth profile as well as the incorporation of alloy nanoparticles with well-defined composition. We applied various methods such as sputtering, evaporation, and plasma polymerization for the deposition of the matrix, and the metallic component was mostly sputter-deposited or evaporated. 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 demonstrate in situ control of the composition of alloy nanoparticles and the ability to fabricate multiple core-shell particles [1-3]. Examples of fabricated nanocomposites range from plasmonic meta-materials with tuned particle surface plasmon resonances through photoswitshable devices to memristors [4,5]. Moreover, we will show a new process for photocatalytic growth of Au nanostructures [6]. In addition to the particulate composites, a new concept of layered magnetoelectric composites will be presented for robust, fully integrable, broadband magnetic field sensors based on the delta E effect [7]. Moreover, we will discuss a novel energy efficient magnetic field sensor [8].

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