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NANOSCIENCE SYMPOSIUM

High energy small angle x-ray scattering and Bragg diffraction to study the nucleation and assembly of nanoparticles

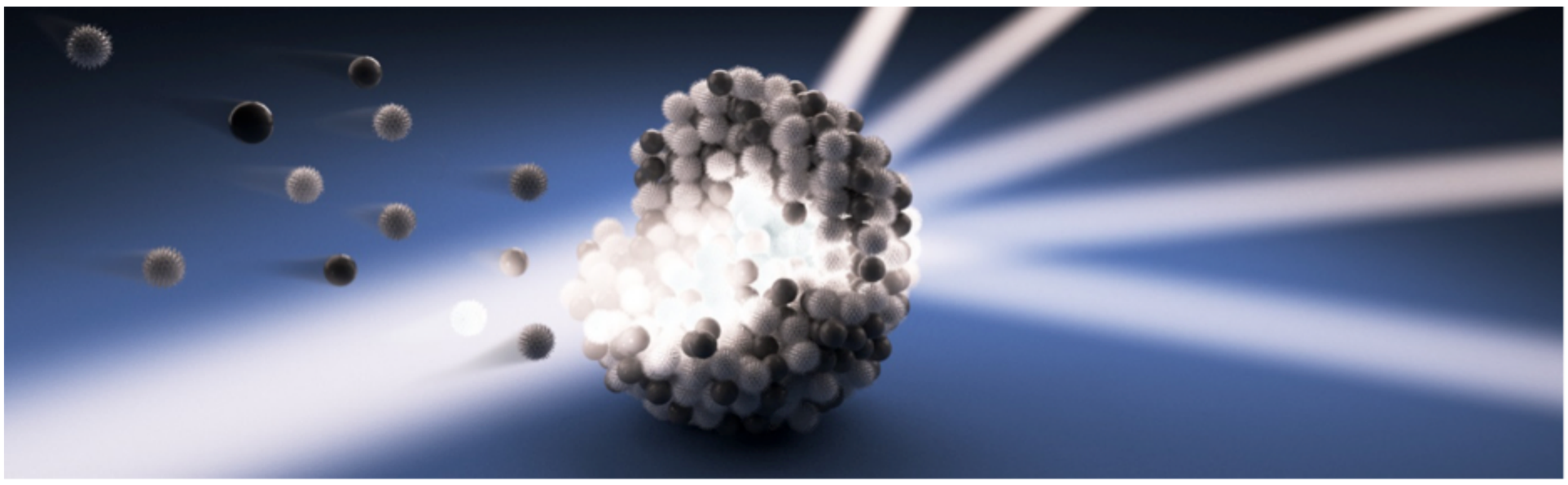
Dr. Bert Nickel

Faculty of Physics, Ludwig-Maximilians-University (LMU), Munich

Abstract:

The synthesis of nanoparticles of controlled size and shape is a complex phenomenon. X-rays can unravel different growth stages, from the early formation of atomic clusters up to nucleation of crystalline nanoparticles, and their assembly in superstructures. The different growth aspects are best probed by complementary scattering techniques, namely small angle scattering, Bragg scattering, and total scattering. I will emphasis the benefit of high energy x-rays and neutrons for this purpose.

We have proposed to combine these techniques simultaneously with the goal to track particle formation on different length scales in real time during synthesis. I will discuss the feasibility of this approach by highlighting several nano-systems studied by us so far, namely perowskite lead halide nanoparticles [1,2] and metal oxide nanoparticles. In all examples studied so far, we find a rather complex nucleation behavior with coexisting phases, intermediate structures, and superstructures, highlighting the need for structural information beyond chemical reaction schemes.



References:

[1] V. Hintermayr, C. Lampe, M. Löw, J. Roemer, W. Vanderlinden, M. Gramlich, A. Böhm, C. Sattler, B. Nickel, T. Lohmueller, Theobald, A. Urban, Polymer nanoreactors shield perovskite nanocrystals from degradation, Nano Letters 19, 4928 (2019

[2] J. Roemer, S. Demchyshyn, A. Böhm, O. Gutowski, K. Frank, N.S. Sariciftci, M. Kaltenbrunner, and B. Nickel, X-ray study of anisotropically shaped metal halide perovskite nanoparticles in tubular pores Applied Physics Letters 113, 251901 (2018)

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