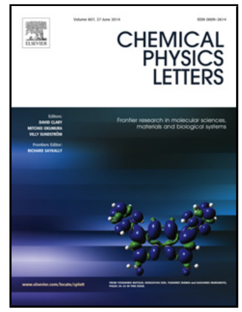

Title: Ripening kinetics of laser-generated plasmonic nanoparticles in different solvents

Author: Bilal Gökce Danielle D. van ‘t Zand Ana Menéndez-Manjón Stephan Barcikowski

PII: S0009-2614(15)00163-3
DOI: http://dx.doi.org/doi:10.1016/j.cplett.2015.03.010
Reference: CPLETT 32856

To appear in:

Received date: 23-1-2015
Revised date: 26-2-2015
Accepted date: 9-3-2015

Ripening kinetics of laser-generated plasmonic nanoparticles in different solvents

Bilal Gökce[1], Danielle D. van 't Zand[1], Ana Menéndez-Manjón[2], and Stephan Barcikowski[1,2]*

[1]Institute of Technical Chemistry I, and Center for Nanointegration Duisburg-Essen (CENIDE), University of Duisburg-Essen, Universitaetsstr. 7, 45141 Essen, Germany

[2]Laser Zentrum Hanover e. V., Hollerithallee 8, 30419 Hanover, Germany

*Corresponding Author: Tel.: +49 201 183-3150, Fax: +49 201 183-3049, Email: stephan.barcikowski@uni-due.de

- Diffusion-controlled growth mechanism for laser-generated nanoparticles is observed by following the surface plasmon resonance
- Solvents have a significant impact on the size, productivity and growth dynamics of laser-generated nanoparticle
- More polar solvents result in smaller particles and a single growth regime
- Less polar solvents lead to a two-step growth mechanism

Pulsed laser ablation in liquid is considered to be a fast nanoparticle-synthesis method taking place on ps to µs timescale. Here, we report the comparably slow ripening kinetics of laser-generated plasmonic nanoparticles (copper, silver, and gold) immediately after ablation. The growth dynamics is studied in situ by following the surface plasmon resonance and correlated to known models. We thereby identify a two-step diffusion-controlled growth mechanism and show the effect of different solvents (water, acetone, ethanol, and ethyl acetate).

One of the most widely studied topics of nanotechnology research is the synthesis, manipulation and application of nanoparticles. Especially plasmonic nanoparticles have aroused considerable attention in recent years due to their unique properties which can be utilized in a number of applications ranging from catalysis,[1] photovoltaics[2] to therapeutics[3,4]. In bio-medical applications, copper and silver nanoparticles are employed as ion-releasing additives in medical nanocomposites[5,6] whereas gold nanoparticles are used in diagnostics[7] and drug delivery research[8]. The synthesis of colloidal gold in water was pioneered by J. Turkevich et al. in 1951,[9] while a method for its synthesis in organic liquids was developed by M. Brust et al.[10] in the early 1990s. An important aspect of the synthesis is the capability of preparing monodisperse solutions of nanoparticles, which was considered initially by La Mer and Dinegar.[11] However, for producing monodisperse nanoparticles fast nucleation is required after which controlled growth and Ostwald ripening of these nuclei can occur.[12-14] It was shown that the monodispersity strongly depends on the duration of the nucleation and that the final size of the nanoparticles is determined by the growth of the nuclei after formation via Ostwald ripening. A method to produce monodisperse