Influence of Cetyltrimethylammonium Bromide on Gold Nanocrystal Formation Studied by in Situ Liquid Cell Scanning Transmission Electron Microscopy - DTU Orbit (07/11/2019)

The synthesis of monodisperse size- and shape-controlled Au nanocrystals is often achieved with cetyltrimethylammonium bromide (CTAB) surfactant; however, its role in the growth of such tailored nanostructures is not well understood. To elucidate the formation mechanism(s) and evolution of the morphology of Au nanocrystals in the early growth stage, we present an in situ liquid-cell scanning transmission electron microscopy (STEM) investigation using electron beam-induced radiolytic species as the reductant. The resulting particle shape at a low beam dose rate is shown to be strongly influenced by the surfactant; the Au nanocrystal growth rate is suppressed by increasing the CTAB concentration. At a low CTAB concentration, the nanoparticles (NPs) follow a reaction-limited growth mechanism, while at high a CTAB concentration the NPs follow a diffusion-limited mechanism, as described by the Lifshitz-Slyozov-Wagner (LSW) model. Moreover, we investigate the temporal evolution of specific NP geometries. The amount of Au reduced by the electron beam outside the irradiated area is quantified to better interpret the nanocrystal growth kinetics, as well as to further develop an understanding of electron beam interactions with nanomaterials toward improving the interpretation of in situ measurements.

General information
Publication status: Published
Organisations: Department of Micro- and Nanotechnology, Molecular Windows, Oak Ridge National Laboratory
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Pages: 2350-2357
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: The Journal of Physical Chemistry Part C
Volume: 122
Issue number: 4
ISSN (Print): 1932-7447
Ratings:
BFI (2018): BFI-level 1
Scopus rating (2018): CiteScore 4.45 SJR 1.652 SNIP 1.083
Web of Science (2018): Indexed yes
Original language: English
DOIs: 10.1021/acs.jpcc.7b06383
Source: FindIt
Source ID: 2389647851
Research output: Contribution to journal › Journal article – Annual report year: 2018 › Research › peer-review