Controlled evaluation of nanoparticle dissolution

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Dissolution is an important transformation that affects the form and concentration of silver nanoparticles (AgNPs) in the environment; however, investigations of AgNP dissolution kinetics are complicated by nanoparticle aggregation. In this study, atomic force microscopy (AFM) was used to monitor the dissolution of un-aggregated, immobilized AgNPs fabricated on glass substrates by nanosphere lithography (NSL). The utility of this method for evaluating nanoparticle dissolution in the absence of aggregation was demonstrated by analyzing the effect of NaCl on AgNP dissolution. Over the first day of exposure to ≥10 mM NaCl, the in-plane AgNP shape changed from triangular to circular, the sidewalls steepened, and the height increased by 6-12 nm. Subsequently, particle height and in-plane radius decreased at a constant rate over a 2-week period. Dissolution rates varied linearly from 0.4 to 2.2 nm/d over the 10-550 mM NaCl concentration range tested. ICP-MS measurements confirmed that NaCl accelerated the release of silver ions from NSL-produced AgNPs into solution. These results suggest that the high levels of NaCl present in biological media and saline waters have the potential to enhance the release of toxic silver ions from AgNPs.

Peter J Vikesland Bio Highlights:

- Vikesland is an NSF CAREER awardee
- During 2012 Vikesland served as the UPS Foundation Visiting Associate Professor at Stanford and was an invited speaker at the Inaugural TEDxVirginia Tech symposium.
- Vikesland and his students have received numerous awards from the American Chemical Society and the American Water Works Association.