Photodynamics of gold nanorod transformation studied by femtosecond coherent diffraction imaging at the European X-FEL

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Functional properties in nanomaterials depend critically on size and shapes, as for instance in photonically active gold nanorods for catalysis and molecular sensing [1]. Laser modification has shown to induce rich product morphologies by laser reshaping [1] or fragmentation [2]. In order to visualize the mechanisms that lead to nanorod reshaping we have performed an ultrafast pump-probe experiment at the EU-XFEL (beamline SPB) [3] to reconstruct the 2D projection of photoexcited single gold nanorods in water as function of delay and laser fluence. By taking advantage of massive sampling at the 500 kHz repetition rate of the XFEL operation it was possible to both derive structural models for the transformation dynamics as well as separate model-independent classes of transformations. The relevance of thermally induced melting-relaxation pathway versus solid-state transformation is discussed.

References

[1] G. González-Rubioet al., Acc. Chem. Res. 49, 678–686 (2016)
[2] A. Plech et al., ACS Nano 18, 10527-10541 (2024)
[3] K. Ayyer et al., Optica 8, 15-23 (2021)