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Tuning the Morphology of Biohybrid β-lg:titania Films with pH for Water-Based and Nanostructured Titania

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Metal oxide interfaces, especially nanostructured titania, play a key role in various energy applications. Achieving controlled morphology at different scales is critical for optimal performance. Nanostructured titania with a high surface-to-volume ratio improves device efficiency. Industrial methods such as spray coating are effective, but often involve unsustainable organic solvents. To address this, water-soluble biopolymers, specifically bovine whey protein ß-lactoglobulin (ß-lg), are being explored as sustainable alternatives. ß-lg acts as a template in water-based titania synthesis, forming different aggregates depending on the pH. Biohybrid films are fabricated using spray deposition with different pH solutions. Investigative techniques provide insight into how pH affects film morphology, including grazing-incidence small-angle neutron and X-ray scattering (GISANS/GISAXS) and real-space imaging. This research aims to develop environmentally friendly, scalable methods for titania-based materials in energy applications, thereby reducing the environmental impact associated with conventional synthesis approaches.

Primary author: HEGER, Julian (TUM School of Natural Sciences, Chair for Functional Materials)

Co-authors: KOUTSIOUMPAS, Alexandros (JCNS); SOCHOR, Benedikt (Deutsches Elektronen-Synchrotron); GEIGER, Christina (Technical University of Munich, Chair of Functional Materials); HARDER, Constantin (DESY); REITEN-BACH, Julija; Dr KREUZER, Lucas (MLZ (FRM II, TUM)); SCHWARTZKOPF, Matthias (DESY); MÜLLER-BUSCHBAUM, Peter (TU München, Physik-Department, LS Funktionelle Materialien); ROTH, Stephan (DESY / KTH); Ms TIANG, Ting (TUM School of Natural Sciences, Chair for Functional Materials); WIDMANN, Tobias (TU München, Physik Department, LS Funktionelle Materialien)

Presenter: HEGER, Julian (TUM School of Natural Sciences, Chair for Functional Materials)

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