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Sustainable biohybrid interfaces: GISANS study on spray deposited whey protein and titania composite films at varying pH

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Metal oxide interfaces are suitable functional materials for various energy applications. For example, TiO₂ can act not only as an anode material in new generation photovoltaic and energy storage technologies, but also in the photocatalytic production of hydrogen. For such applications, a controlled morphology on distinct length scales is particularly important to fulfill optimal performance conditions. Furthermore, a high interfacial area and, hence, a high surface-to-volume ratio of nanostructured TiO₂ is beneficial for devices. Industrial-relevant deposition methods, such as spray coating, are applicable to fabricate intended morphologies by low-cost solution processing via diblock copolymer-directed sol-gel synthesis. When it comes to an industrial scale, however, limiting factors affecting sustainability are the commonly involved organic solvents. Water-soluble biopolymers can replace synthetic copolymers to facilitate sustainable production. The bovine whey protein β -lactoglobulin (β -lg) can act as a template in water-based TiO₂ synthesis forming aggregates of different structures by denaturing at different pH values. In this work, biohybrid films are obtained from solutions with decreasing pH using spray deposition. Bulk and surface-sensitive grazing-incidence small-angle neutron scattering (GISANS) investigations yield an understanding of the influence of pH on the biohybrid film's morphologies. Real-space imaging complement the obtained results.

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