Insights into the Immobilization of Enzymes onto Hybrid Isotropic and Janus Particles

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The design of colloidal core-shell particles with advanced architectures and tailored properties provides an excellent base for the immobilization of catalytically active species, such as enzymes [1,2] and metal nanoparticles [3], which may enhance their structural and catalytic stability, reducing product inhibition and facilitating their recovery.

Herein, we report on the synthesis of hybrid isotropic and Janus particles with controllable size, geometry, grafting density, polymer chain length, and chemical functionality to control the interfacial properties of the particles (Fig. 1a,c).[1,2] We propose the immobilization of laccase from *Trametes versicolor* onto these particles as an application that would benefit from the unique properties as well as chemical and geometrical anisotropy of these carrier materials (Fig. 1b).[1,2] Further, we discuss the correlation between the controlled design of polymeric interface and its impact on the immobilization yield and enzymatic structure of laccase, as well as occurring changes in the surface morphology, charge and adhesion performance of the final polymer-enzyme layer.[1,2] Moreover, the best performing system offering an immobilization yield of 92% and activity of 5.7 kU/(g particle) was successfully used for the decolorization of Cibacron Blue P-3R in up to 18 cycles.[2] To exploit the superior interfacial activity and recovery of Janus particles, we selectively modify one of their sides with enzyme, and the other hemisphere with a thermo-switchable adhesive polymer. This detailed study contributes to the understanding of the rational design of catalytically active and easily recoverable hybrid materials for applications in textile industry and environmental technologies.[1-3]

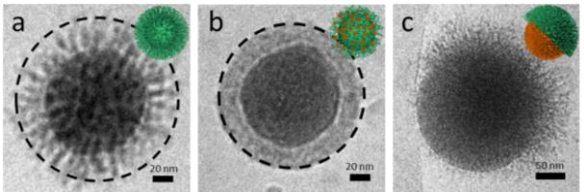

Figure 1: (a) Representative cryo-TEM images of (a) an isotropic hybrid particle without immobilized enzyme, (b) an isotropic hybrid particle with immobilized laccase from *Trametes versicolor*, and (c) a hybrid Janus particle. Insets show schematic illustrations.

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