Brushing the surface: cascade reactions between immobilized nanoreactors

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Functionalization of hard or soft surfaces with, for example, ligands, enzymes or proteins, is an effective and practical methodology for the development of new applications. We report the assembly of two types of nanoreactors based upon poly(dimethylsiloxane)-block-poly(2-methyl-2-oxazoline) (PDMS-b-PMOXA) diblock copolymers as scaffold, uricase and lactoperoxidase as bio-catalysts located within the nanoreactors, and melittin as the biopores inserted into the hydrophobic shell. The nanoreactors were immobilized on poly(2-hydroxyethyl methacrylate)-co-poly(2-aminoethyl methacrylate hydrochloride) (PHEMA-co-P(2-AEMAÂůHCl) brushes-grafted wafer surfaces by utilizing the strong supramolecular interactions between biotin and streptavidin. The (PHEMA-co-P(2-AEMAÂůHCl) brushes on silicon surfaces were prepared by a surface initiating atom transfer radical polymerization (ATRP) ”graft-from” technique. Cascade reactions between different surface-anchored nanoreactors were demonstrated by converting Amplex Red to the fluorescent probe resorufin by using the H2O2 produced from uric acid and H2O. The detailed properties of the nanoreactors on the functionalized surface including the binding behaviours and cascade reactions were investigated using emission spectroscopy, transmission electron microscopy (TEM), light scattering (LS), atomic force microscopy (AFM) and a quartz crystal microbalance (QCM-D). The results are proof-of-principle for the preparation of catalytically functional engineered surface materials and lay the foundation for applying this advanced functional surface material in biosensing, implanting and antimicrobial materials preparation.

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