

Single-Enzyme Nanogels for High-Performance Nanobiocatalysis

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In order to potentiate biocatalytic processes, a simple, one-pot, enzyme encapsulation protocol was developed to produce single-enzyme nanogels (SENs).[1]

SENs exhibit overall improved resistance against thermal degradation and proteases, enhanced tolerability to organic solvents, as well as retention of catalytic activities of enzymes over broadened pH ranges.[1,2] Additionally, controlled surface immobilization of multiple SENs was successful by patterning *via* microcontact printing onto thiol-functionalized glass surfaces.[2]

A careful regulation of the overall reagent concentration during polymerization efficiently ensures full control over the generation of the crosslinked polyacrylamide layer at the surface of the enzyme molecules. Thicknesses in the range of 0.5–8 nm may be attained for SENs, ensuring regulation of catalytic activity vs. improved enzyme stabilization.

These features overall concur to the development of robust nanobiocatalysts, showing broadened ranges of enzyme applicability. Further, a library of hydrophilic polymers and enzymes were screened for the successful formation of SENs. The addition of 5 w/v% sucrose allowed for a surface-directed polymerization, without the need to pre-modify the protein surface.[1] Biocompatibility was ensured by the formation of SENs based on FDA-approved polymers that do not show any immunogenicity onto humans.[3] The formation of a thin crosslinked polymeric layer at the surface of biologically relevant enzymes is a solid approach for improved resistance to proteolytic degradation or immunogenicity, when compared to conventional surface grafting of linear polymers.[4]

References

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Figures

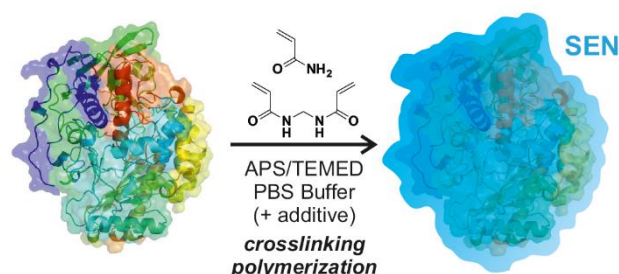


Figure 1. SEN formation via a one-step, free-radical crosslinking polymerization.

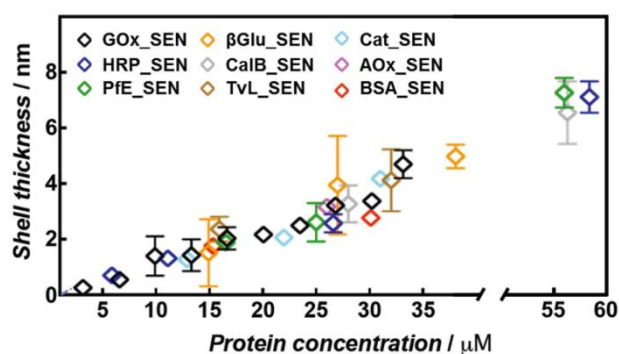


Figure 2. SEN formation as a protein-independent process.