Abstract

Surface Patterning For Enhanced Protein Stability

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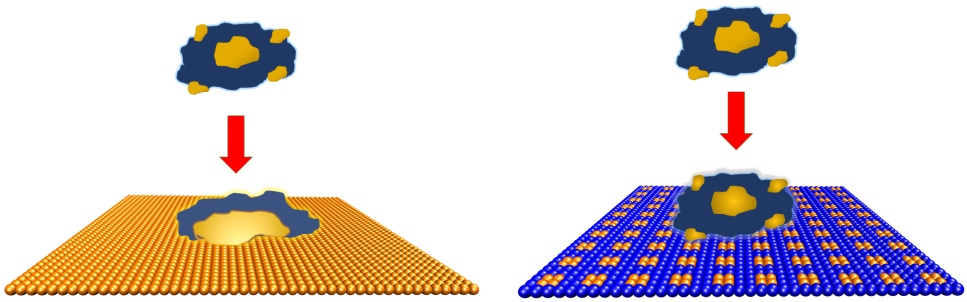
Reduced activity of enzymes upon immobilization is a major challenge for the industrial use of enzymes. Enzyme-surface interactions and interactions between the immobilized enzymes are thought of as the main reasons for the reduced activity.

In my research work, we study the thermal and structural stability of proteins on a patterned hydrophobic surface in the framework of a hydrophobic-polar (HP) lattice model. Our results indicate that, while a homogeneous hydrophobic surface denatures the proteins, carefully patterned surfaces can dramatically increase the stability of adsorbed proteins. The size, shape, and the distance between surface patterns play a significant role in determining the stability of proteins. When the spacing between the patterns is large, maximum stability is observed when the surface pattern is complementary to the exposed hydrophobic domain of the protein, while at lower spacing, patterns with lower hydrophobicity stabilize the protein more compared to the complementary pattern.

The findings from the paper can be rationalized to design novel enzyme-specific surfaces for immobilization with current enzymatic activity.



(a) (b)

Pictorial representation of the proposed idea. Blue represents hydrophilic groups. Orange represents hydrophobic groups. In bulk (i.e., water), the native structure of the protein has a hydrophobic core surrounded by the polar exterior. (A) Proteins lose their biological activity on interaction with the homogeneous hydrophobic surface upon adsorption. (B) Proteins retain its biological activity on interaction with the patterned surface upon adsorption.