Bio-inspired Silification for Biointerface Design

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Silicatein (SIL) involved in biosilification in diatoms has high identity and similarity with cathepsin L. We obtained novel hypothetical cathepsin-like protein (CAT) from Nematostella vectensis. This CAT expressed in E. coli displayed not only protease activity but also silica condensing activity. To increase the silica forming activity, some residues including cysteine in active site were changed into silicatein conserved residues. The mutant silicatein-like cathepsin (SLC) showed increased expression level in E. coli and silica forming activity comparable to that of SIL and decreased protease activity as compared to CAT. SIL, CAT and SLC fused with GST were arrayed on GSH-coated plate and catalyzed the formation of silica layer in the presence of TEOS as substrate at ambient and neutral conditions. During biosilification, GFP or HRP was immobilized on silica surface by simple adding it. Immobilized proteins retained their activity and were released gradually. This immobilization technique can be applied to form biocompatible silica coating for diagnostic, catalytic and matrix for tissue cultures, and surface treatment for biosensor.