

Protein-Based Next-Generation Smart Adhesive Biomaterials for Tissue and Biomedical Engineering Applications

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Marine mussel adhesion is known to be mediated by mussel adhesive proteins (MAPs), which are secreted through the mussel byssus and have great potential as biologically and environmentally friendly adhesive biomaterials due to their biocompatibility and biodegradability. In addition, MAPs have strong adhesion ability even on wet surfaces due to unique amino acid arrangements and composition. However, researches using the natural amino acid composition of MAPs have been limited due to difficulties in obtaining sufficient quantities of MAPs for practical applications. We successfully and massively produced genetically redesigned new fusion MAP using a bacterial expression system, and this fusion protein showed significant adhesion ability. In addition, using the superior cell adhesion properties and fusion technology of the bioactive extracellular matrix (ECM) peptides, we discovered the great potential of MAPs as bio-functional smart biomaterials for tissue and biomedical engineering applications. We also demonstrated the multi-functional roles of MAPs as coating materials for bone regeneration as well as components of nanofibrous scaffolds.