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Developing strategies to toughen bio-inspired adhesives

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ABSTRACT

Mussels and other marine creatures adhere very well in underwater environments, having the ability to withstand the force of the sea. These animals have inspired synthetic biomimetic adhesives for wet systems, presenting potential for biomedical applications. However, most current commercial adhesives tend to be brittle, not resisting repetitive movements. This study assesses toughening strategies to improve the mussel-inspired adhesives' ductility while maintaining its strength. The strategies included altering the polymer's chemical structure by changing the percentage of polyethylene glycol (PEG) in the molecule and by adding fillers, such as calcium carbonate, silica and nacre - a calcium carbonate compound found in shells. The dry adhesion of the glues was tested by shear lap tests on standard aluminum samples. The addition of PEG increased the ductility of the polymer considerably, creating a viscous paste rather than a solid. Future advances include analyzing the tensile strength and adhesion of the systems, as well as their resistance in wet environments. Furthermore, the toxicity of both the polymer and potential fillers should be investigated.

KEYWORDS

adhesives, bio-inspired, toughening, strength, ductility, mussels, biomedical, glue.