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Polymer adhesion at surfaces: biological adhesive proteins and their synthetic mimics[1]

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Mussels are famous for their ability to permanently adhere to a wide variety of wet surfaces, such as rocks, metal and polymer ship hulls, and wood structures. They accomplish this through specialized proteins collectively referred to as mussel adhesive proteins (MAPs). The biophysical aspects of MAP adhesion is being revealed through the use of single molecule force measurements. The results provide insight into the adhesive roles of key amino acids found in these proteins, including the magnitude of adhesive forces, cooperative effects, and their self-healing properties. This molecular-level information is being incorporated into designs of biomimetic polymer coatings for a variety of applications. Our biomimetic approach to polymer design will be illustrated by a few examples where adhesive constituents found in MAPs are exploited to make wet-adhesive polymer coatings. In addition, small molecule analogs of MAPs can be used to apply thin functional films onto virtually any material surface using a facile approach. These coatings have a variety of potential uses in microelectronics, water treatment, prevention of environmental biofouling, and for control of biointerfacial phenomena at the surfaces of medical/diagnostic devices.

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