A Role for Metal Ions in Marine Biomaterial Formation

Steven M. Howell, Mary J. Sever, Jaime T. Weisser, and Jonathan J. Wilker

Department of Chemistry, Purdue University

Marine organisms such as the common blue mussel, barnacles, and reef building worms construct impressive adhesive materials with properties unrivaled by current human technology. Such biomaterials have the remarkable ability to adhere strongly in the wet, stress-filled, and extremely turbulent intertidal zone. Marine mussels affix themselves to rocks and other substrata by producing protein-based glues. Soluble proteins are placed onto a surface followed by cross-linking of these biopolymers to yield a hardened matrix for securing the animal in place (Figure 1).[1,2] These protein precursors to adhesion contain the unusual amino acid 3,4-dihydroxyphenylalanine (DOPA).[1,2] We are working with inorganic complexes, small synthetic peptides, protein extracted from the animals, and live mussels in an effort to elucidate the chemistry behind how these biomaterials are created and function. Utilizing various biochemical, spectroscopic, synthetic, and materials engineering techniques, we have found evidence suggesting that iron is the initiator of protein cross-linking and formation of the adhesive.[3,4] More specifically, our data indicate that dioxygen reactions at the iron center lie at the heart of biomaterial generation by marine mussels.[4]

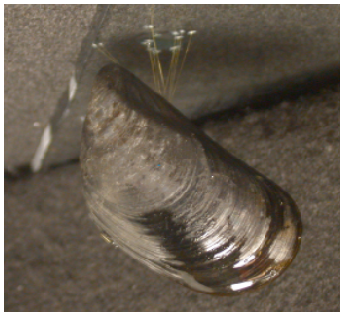

Figure 1. Photograph of a marine mussel adhering to a glass sheet.

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[2] Deming, T. J. *Curr. Op. Chem. Biol.* **1999**, *3*, 100-105.
[3] Monahan, J.; Wilker, J. J. *Chem. Comm.* **2003**, *14*, 1672-1673.
[4] Sever, M. J.; Weisser, J. T.; Monahan, J.; Srinivasan, S.; Wilker, J. J. *Angew. Chem. Int. Ed.* **2004**, *43*, 448-450.