# Bioinspired tricks and consequences in adhering underwater: From hydrophobicity to non-ionic coacervation

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Exceeding the confined layer of water and efficiently adhering to substrates underwater remain as an enduring challenge for material scientists. However, marine life-forms such as mussels and sandcastle worms possess bio-adhesive strategies to sustain their life cycle underwater. Mussels secrete a series of primer proteins (Mfp) containing a post-translationally modified amino acid 3,4-dihydroxyphenylalanine (DOPA). DOPA is shown to enhance the adhesion of Mfp. Inspired by the strong underwater adhesion of Mfp, we synthesized a series of adhesives incorporated with DOPA with varying hydrophobicity. We found that the DOPA-incorporated hydrophilic polymers failed to adhere underwater, while the hydrophobic polymers showed remarkable adhesion strength underwater (~ 1 MPa). We took a step further to analyze the contact interfaces of these adhesives with adhesion testing using JKR geometry and using sum-frequency generation spectroscopy. Correlating the macroscopic adhesion and the spectroscopic features of the nanometer thick contact interface, we directly observed the crucial roles of modulus and hydrophobic functional groups in establishing underwater contact and multimodal hydrogen bonding of DOPA in perpetuating the contact. In addition to the chemistry responsible for underwater adhesion, the presentation will cover our recent advancements in designing non-ionic coacervates that are stable in all ranges of pH and wide ranges of ionic strength and show rapid adhesion underwater.