World Academy of Science, Engineering and Technology
International Journal of Biomedical and Biological Engineering
Vol:18, No:08, 2024

The Three-dimensional Response of Mussel Plaque Anchoring to Wet Substrates under Directional Tensions

Authors : Yingwei Hou, Tao Liu, Yong Pang

Abstract : The paper explored the three-dimensional deformation of mussel plaques anchor to wet polydimethylsiloxane (PDMS) substrates under tension stress with different angles. Mussel plaques exhibiting natural adhesive structures, have attracted significant attention for their remarkable adhesion properties. Understanding their behavior under mechanical stress, particularly in a three-dimensional context, holds immense relevance for biomimetic material design and bio-inspired adhesive development. This study employed a novel approach to investigate the 3D deformation of the PDMS substrates anchored by mussel plaques subjected to controlled tension. Utilizing our customized stereo digital image correlation technique and mechanical mechanics analyses, we found the distributions of the displacement and resultant force on the substrate became concentrated under the plaque. Adhesion and sucking mechanisms were analyzed for the mussel plaque-substrate system under tension until detachment. The experimental findings were compared with a developed model using finite element analysis and the results provide new insights into mussels' attachment mechanism. This research not only contributes to the fundamental understanding of biological adhesion but also holds promising implications for the design of innovative adhesive materials with applications in fields such as medical adhesives, underwater technologies, and industrial bonding. The comprehensive exploration of mussel plaque behavior in three dimensions is important for advancements in biomimicry and materials science, fostering the development of adhesives that emulate nature's efficiency.

Keywords : adhesion mechanism, mytilus edulis, mussel plaque, stereo digital image correlation
Conference Title : ICBBE 2024 : International Conference on Biomechanics and Biomedical Engineering
Conference Location : Budapest, Hungary
Conference Dates : August 22-23, 2024