CEC-DOPA AS A PROTEIN HYDROGEL FOR WET ADHESIVES

Ishwarya Krishna, Jacob Kronenberg, Maria Kulapurathazhe, Jessica Wong, and Jin Kim Montclare. Department of Chemical and Biomolecular Engineering. New York University, Brooklyn, NY 11201

Wound healing involves a stage of inflammation, which can be prolonged in patients with diseases such as diabetes, leading to discomfort and poor patient outcomes. Hydrogels have the potential to promote recovery, serving as scaffolds for sustained drug release. Many hydrogels available today are either harmful to the patient or dysfunctional in wet environments. We are investigating protein engineered biomaterial as a possible wet-adhesive hydrogel for drug delivery.

Our lab has engineered CEC, a triblock polymer composed of two cartilage oligomeric matrix protein coiled-coil domains (C), and one elastin-like polypeptide domain (E). It has good mechanical properties, can bind to small molecules, and responds to stimuli such as temperature, pH, or cation concentration. Previous work has successfully created photopatterned hydrogels that sustain small molecule release, and ongoing work incorporates non-canonical amino acids into the hydrogels to further increase adhesive properties. Dihydroxyphenylalanine (DOPA) is a non-canonical amino acid found in naturally occurring adhesive proteins in mussels. The residue-specific incorporation of DOPA into CEC produces a variant with increased adhesive properties through increased hydrogen bonding with other surfaces.

We compared two incorporation processes of DOPA to determine what contributes to CEC's mechanical properties: post-translational modification by tyrosinase, as well as residue-specific incorporation. The characterization of CEC-Y (where Y represents tyrosine) as a negative control and CEC-DOPA confirmed the adhesive properties of DOPA. Having expressed CEC-DOPA and CEC-Y, the conformations and mechanical properties of CEC-DOPA over CEC-Y were characterized using circular dichroism and rheology. The results of CEC-DOPA confirm the feasibility of CEC-DOPA as a material for a wet-adhesive hydrogel drug delivery system.

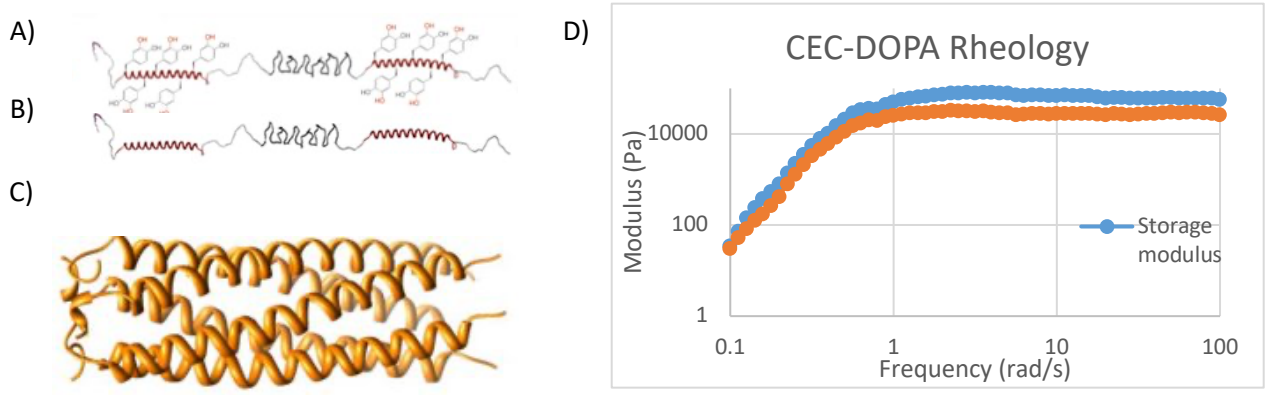

Figure 1: (A) Protein structure of the triblock copolymer CEC-DOPA and its negative control, (B) CEC-Y, below it. (C) Computational model of cartilage oligomeric protein coiled-coil domain of CEC (D) Rheology data worked up into a graph of the storage and loss modulus as a function of frequency.