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Ultra-tough and strong, hybrid thin films based on ionically crosslinked polymers and 2D inorganic platelets DONG HWAN JI, SUJI CHOI, JAEYUN KIM, Sungkyunkwan Univ, NANOBIOMATERIALS LAB TEAM — Integration of high strength and toughness tend to be mutually exclusive and synthesized hybrid films with superior mechanical properties have been difficult to fabricate controllable shapes and various scales. Although diverse synthesized hybrid films consisting of organic matrix and inorganic materials with brick-and-mortar structure, show improved mechanical properties, these films are still limited in toughness and fabrication methods. Herein, we report ultra-tough and strong hybrid thin films with self-assembled uniform microstructures with controllable shapes and various scale based on hydrogel-mediated process. Ca^{2+}-crosslinking in alginate chains and well-aligned alumina platelets in alginate matrix lead to a synergistic enhancement of strength and toughness in the resulting film. Consequentially, Ca^{2+}-crosslinked Alg/Alu films showed outstanding toughness of 29 MJ m^{-3} and tensile strength of 160 MPa. Furthermore, modifying Alu surface with polyvinylpyrrolidone (PVP), tensile strength was further improved up to 200 MPa. Our results suggest an alternative approach to design and processing of self-assembled hydrogel-mediated hybrid films with outstanding mechanical properties.

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