

The Hybrid Films Composed of Alginate and Alumina with Enhanced Strength and Toughness at Low Inorganic Content

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Inspired from natural materials, artificial hybrid films have been developed to enhance mechanical properties. The developed hybrid films are usually composed of man-made polymers and inorganic particles, fabricated by vacuum-assisted filtration and bottom-up assembly. The enhanced mechanical properties of these films are usually attributed to high inorganic contents and interactions between inorganic parts and polymers. Here, we present hybrid films, composed of biopolymer alginate (Alg) and alumina platelets (Alu) with outstanding mechanical properties at low inorganic content around 5 wt%. Alumina platelets were well-aligned and incorporated in Alg matrix, improving tensile strength and toughness of the films. Furthermore, additional ionic crosslinking of Alg, resulted in synergistic improvement of strength and toughness. Crosslinked Alg/Alu films with low inorganic content showed tensile strength of 155 MPa and toughness of 29 MJ/m³, 2.3 and 7.2 times higher tensile strength and toughness, respectively, compared to control Alg film. Our results provide an alternative direction for design and fabrication of artificial hybrid films.