Adaptive amphiphilic surface adhesion mechanism of HPMC in aqueous environment

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Hydroxypropyl methylcellulose, an FDA-approved water-soluble cellulose derivative, has been used in various wet-adhesion applications in construction products and drug delivery for 70 years. Despite the various applications, its adhesion mechanism in water has not been elucidated. Here, we measure the adhesion characteristics of HPMC against itself, hydrophilic and hydrophobic surfaces as a function of temperature using a surface forces apparatus in water. The results show that HPMC adheres strongly to all tested surfaces, regardless of hydrophobicity. In addition, the elevated temperature induces swelling in HPMC layer, resulting in the exposure of more hydrogen bonding sites, thereby increasing adhesion with the hydrophilic surface. The bulk compression test of the HPMC-silica composite material is consistent with the SFA data and indicates that the water content and temperature are critical variables for the adhesion of HPMC to inorganic surfaces regardless of hydrophobicity.