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Healing of Crack on Brittle Substrate by Dual Cross-Linked Nanogel Coating GERMAN KOLMAKOV, Chemical and Petroleum Engineering Department, University of Pittsburgh, Pittsburgh, PA 15261, USA, KRZYSZTOF MATYJASZEWSKI, Department of Chemistry, Carnegie Mellon University, Pittsburgh, PA, 15213, USA, ANNA BALAZS, Chemical and Petroleum Engineering Department, University of Pittsburgh, Pittsburgh, PA 15261, USA — We use computational modeling to design a gel coating that undergoes structural rearrangement in response to mechanical stress, and thereby prevents catastrophic failure of the underlying brittle substrate. The material is composed of nanoscopic polymer gel particles, which are connected by a network of labile and strong, stable bonds. The stable bonds between the nanogels play an essential role by imparting structural integrity, and the reactive, labile bonds provide the healing properties. We demonstrate that the combination of capillary and van der Waals forces, and an external load draws the nanogel particles into the crack on the surface of the substrate. Within this crack, the nanogel particles can bind to the exposed surface, fill the void and thereby, effectively heal the damaged region. The introduction of nanoparticles into the gels units leads to an increase in the strength of the coating. The results provide guidelines for designing polymer coatings that extend the life span of the entire structure by imparting self-healing mechanisms into the system.

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