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Rapid Self-healing Nanocomposite Hydrogel with Tunable Dynamic Mechanics QIAOCHU LI, Massachusetts Institute of Technology, SUMEET MISHRA, BRIAN CHAPMAN, North Carolina State University, PANGKUAN CHEN, Massachusetts Institute of Technology, JOSEPH TRACY, North Carolina State University, NIELS HOLTEN-ANDERSEN, Massachusetts Institute of Technology — The macroscopic healing rate and efficiency in self-repairing hydrogel materials are largely determined by the dissociation dynamics of their polymer network, which is hardly achieved in a controllable manner. Inspired by mussel's adhesion chemistry, we developed a novel approach to assemble inorganic nanoparticles and catechol-decorated PEG polymer into a hydrogel network. When utilized as reversible polymer-particle crosslinks, catechol-metal coordination bonds yield a unique gel network with dynamic mechanics controlled directly by interfacial crosslink structure. Taking advantage of this structure-property relationship at polymer-particle interfaces, we designed a hierarchically structured hybrid gel with two distinct relaxation timescales. By tuning the relative contribution of the two relaxation modes, we are able to finely control the gel's dynamic mechanical behavior from a viscoelastic fluid to a stiff solid, yet preserving its rapid self-healing property without the need for external stimuli.

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