# Versatile, bioinspired structural composite hydrogels with a desirable combination of strength, stiffness, and toughness

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In the development of artificial hydrogels, emulating the mechanical properties of biological tissues with a desirable combination of stiffness and toughness is crucial. To achieve such properties, we applied a design principle inspired by a natural structural composite to wet hydrogels. The bioinspired structural composite hydrogel consisting of layered alumina microplatelets and double-network polymer matrices with strong polymer–platelet interactions was fabricated by a facile method. The resulting hydrogel exhibited a combination of high tensile strength and elastic modulus (on the order of several MPa) and high fracture energy (up to ~2 $kJ \cdot m^{-2}$). Such results demonstrate the potential of a bioinspired approach that has been limitedly applied in dry composites for developing mechanically robust composite hydrogels. Furthermore, when the resulting hydrogel is utilized as a bioelectronic substrate, it would be expected to prevent damage from heat localization and short-circuit by electrodes owing to the layer-by-layer aligned alumina platelets.