Bio-inspired mechano-functional gels through multi-phase order-structure engineering

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Adaptive gel materials can greatly change shape and volume in response to diverse stimuli, and thus have attracted considerable attention due to their promising applications in soft robots, flexible electronics and sensors. In biological soft tissues, the dynamic coexistence of opposing components (for example, hydrophilic and oleophilic molecules, organic and inorganic species) is crucial to provide biological materials with complementary functionalities (for example, elasticity, freezing tolerance and adaptivity). Taking inspiration from nature, we developed a series of high mechanical performance soft active materials, so-called organohydrogels, based on multiphase synergistic strategy. Traditional techniques such as post-polymerization modification, interpenetrating network and controlled micro-phase separation are combined with binary complementary concept to design and fabricate new organohydrogels with diverse topology of heteronetworks. Meanwhile, the synergistic effect of heteronetworks provided the organohydrogels with unprecedented mechanical functions such as freeze-tolerance, programmed high-strain shape memory and shaking insulation. Their applications in anti-biofouling, thin-film fabrication, flexible electronics and actuators are also explored.

References:

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刘明杰，北京航空航天大学化学学院院长、长江学者特聘教授、国家杰出青年科学基金获得者。主要从事仿生高分子复合凝胶的研究，并开展了其在防污减阻、软体机器人及可穿戴设备等领域的应用探索。近年来在 Nature, Nat. Rev. Mater., Nat. Commun., Sci. Adv., Angew. Chem. Int. Ed., Adv. Mater.等共发表 SCI 论文 90 余篇。先后主持国家重点研发计划青年项目、国家自然科学基金、国防科技创新特区等科研项目。目前担任中国化学会高分子学科委员会委员，学术期刊《高分子学报》、《Polymer》、《Giant》编委等职务。曾获国际仿生工程学会杰出青年奖，中国化学会纳米化学新锐奖，日本理化学研究所研究创新奖等。