Investigation of the Formulation and Properties of Multi-Stimuli Responsive Smart Hydrogels

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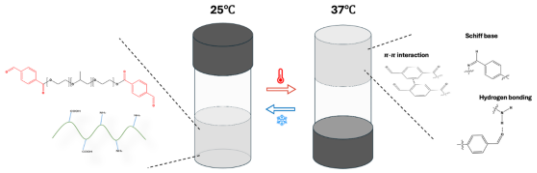
Smart hydrogels are a highly versatile and innovative class of materials, characterized by their ability to respond to specific environmental stimuli such as temperature, pH, light, electric fields, or chemical agents. This responsiveness makes them exceptionally valuable for advanced applications across a wide range of fields, including biomedicine, environmental engineering, and soft robotics.[1] Our research team has recently developed temperature-responsive hydrogels, showcasing outstanding cell viability and biocompatibility with human mesenchymal stem cells. These findings underscore their potential as innovative biomaterials and implantable scaffolds for applications in tissue engineering and regenerative medicine.[2] Additionally, we have successfully engineered light-responsive hydrogels, leading to the advancement of pioneering technologies in light-switchable adhesives.[3]

In this work, we successfully developed a reversible temperature-responsive hydrogel with the ability to dynamically adjust its mechanical properties in response to external stimuli. This was achieved by chemically modifying F108 and combining it with gelatin to form a composite hydrogel. Through systematic optimization of the hydrogel formulation, we significantly reduced the gelation time, making the manufacturing process more efficient and practical. The resulting hydrogel demonstrated outstanding responsiveness, self-healing capabilities, and adaptability, underscoring its potential for cutting-edge applications in soft robotics, biomedical engineering, and advanced smart materials. Its ability to undergo rapid gelation while maintaining robust functionality highlights a unique combination of properties, including thermal sensitivity, mechanical resilience, and versatile performance. These characteristics not only open new avenues for the creation of innovative smart materials but also provide a solid foundation for their implementation in various fields requiring dynamic and responsive material solutions.



1) K. Wang, J. Zhang, H. Li, J. Wu, Q. Wan, T. Chen, W. Liu, H. Peng, H. Zhang, Y. Luo, *Adv. Sensor Res.*, **2024**, 3, 2400003. 2) M.-Y. Yeh, J.-Y. Zhao, Y.-R. Hsieh, J.-H. Lin, F.-Y. Chen, R. D. Chakravarthy, P.-C. Chung, H.-C. Lin, S.-C. Hung, *RSC Adv.*, 2017,7, 21252. 3) Y.-Y. Wang, P.-W. Chen, Y.-H. Chen, M.-Y. Yeh, *Mater. Horiz.*, **2025**, Advance Article