**Editorial**
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# Techniques for Manufacturing of Hydrogel Actuators and Sensors

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## Editorial

Numerous bio-sensors and actuators are found throughout living things, which allow them to sense their environment and move in response. Because of their great biocompatibility and resemblance to biological organs' mechanical and electrical properties, hydrogels have been regarded as the best possible materials for making bio-sensors and actuators. The key to producing hydrogel sensors and actuators is to ensure that the materials have great mechanical and electrical properties as well as the ability to effectively interfacially link to a variety of substrates. Modifying hydrogels requires manufacturing and post-treatment procedures, just as iron must be toughened and hardened to become steel. Additionally, sophisticated design and manufacturing techniques can create strong contacts between actuators and other substrates, boosting the intended mechanical and electrical performances. Despite the fact that numerous literatures have evaluated the construction or modification of hydrogels, there is still a paucity of information regarding post-treatment techniques and the development of successful electrical and mechanically sustainable interfaces. Hydrogels with several functions have potential uses as wearable sensors and actuators. The development of a photo thermally sensitive conductive hydrogel with high transparency, mechanical qualities, a wide sensing range, and low-temperature resistance is still a difficult task. Even in tough settings, the transparent hydrogel-based sensor exhibits a wide sensing range and cycle stability in detecting deformations and real-time human motions. In order to produce transparent multifunctional hydrogels for remote actuation and strain sensing applications, this work offers a new method.

Although layered hydrogel actuators have received a lot of attention, achieving fast bending in a short amount of time remains difficult. Thermo responsive bilayer hydrogel actuator is used in this work [1]. The bilayer was given due to the stark disparity in the deswelling rates of the two layers. The bilayer hydrogel was given due to the significant disparity in the deswelling rates of the two layers. The bilayer hydrogel was successfully realised as a fluid valve, a hydrogel flower to mimic the opening and shutting of petals, and a four-armed gripper for toys, opening up a wide range of possible applications in sectors like environmental sensors, soft robotics, and biomedical engineering [2]. Although stimuli-responsive hydrogels are being used increasingly in soft actuators and robotics, their poor mechanical characteristics, low driving force, and slow actuation speed present hurdles in real-world applications.

The creation of biostructures that can imitate the movement of natural systems through remote actuation is drawing a lot of interest in soft materials. For creating dynamic and biocompatible soft structures for soft actuators and related biomedical devices, multi-sensitive hydrogels are among the best materials. However, the development of bioinks that can be 3D printed and are based on naturally occurring and stimuli responsive hydrogels continues to be difficult for advanced applications. Holographic patterns embedded in responsive hydrogels make up hydrogel-based holographic sensors, which diffract light at various wavelengths in response to changes in the material's size and refractive index. Since hydrogels' material composition may be specifically tailored to respond to various stimuli, the diffraction pattern can be used to determine how much analyte is present [3]. This overarching idea has led to the implementation of several strategies to produce label-free optical sensors and biosensors, with benefits like simple manufacture or detection by the naked eye. An overview of the various strategies, sensing components, measurement theories, detection configurations, and outlooks for the future are provided. Hydrogel actuators are a subset of intelligent soft materials that can perform anisotropic thrust and/or displacement in response to a variety of environmental cues, such as temperature, light, pH, humidity, etc.

High-performance hydrogel actuators must have strong durability and quick response. Here, we present the synthesis and mechanical property studies of several new organic-inorganic hydrogels employing silicon nanoparticles that have been vinyl functionalized [4]. The development of "smart" hydrogels into sensors, actuators, or artificial muscles has recently focused on those having shape memory behaviour or reversible actuation. These shape-deformable three-dimensional polymer networks exhibit a volume phase shift after being stimulated by outside physicochemical factors. Here, we examine new developments and various shape memory hydrogel types [5]. Additionally, stimuli-responsive hydrogel actuators have been studied with an emphasis on their stimulation, motion-deformation procedures, and microfabrication used in hydrogel-based actuators. Furthermore, their applications are defined and addressed using concrete examples.

In response to temperature, these hydrogel actuators demonstrated quick bending velocity, great stability, and outstanding cycle performance. Importantly, these hydrogel actuators could be created as soft robots that lift and move items by adjusting the temperature of their surroundings. This research offered a simple but effective method for creating soft actuators with great strength and quick response times.

## Conflict of Interest

None.

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