Materials & Chemicals

Improved Infrared-Responsive Hydrogel for Use in Microfluidics and Optics

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WARF: P120025US01

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a composite hydrogel comprising graphene oxide flakes for increased volumetric flux and broader spectrum light responsiveness.

Overview

Responsive hydrogels can respond to external stimuli such as temperature, pH, photons and antigens, which makes them applicable as functional materials in drug/gene delivery devices, microlenses and sensors. Light-responsive hydrogels are particularly valuable since activation via light can be remote and noninvasive. Thermo-responsive hydrogels have been shown to possess light responsiveness for microfluidic applications when gold nanoparticles are incorporated into the polymer matrix. Exposure to infrared light causes the hydrogel to heat up, which in turn causes it to contract and release water. When the light source is off, the heat dissipates, causing the hydrogel to absorb water and expand to its original volume. However, the volumetric change for gold composite hydrogels does not seem to be significantly more than that of conventional responsive hydrogels. An improved composite hydrogel for use in micromechanical devices is needed.

The Invention

UW–Madison researchers have developed an improved infrared-responsive hydrogel by incorporating graphene oxide flakes into a thermo-responsive hydrogel polymer. These composite hydrogels have an intrinsically higher surface area and absorbance band than conventional metal nanoparticles, resulting in a larger volumetric change in response to infrared light. The researchers also have provided a microfluidic device and a lens structure that incorporate these composite hydrogels as actuators. Both devices can be operated by heating the composite hydrogel in its swollen state to a temperature sufficient enough to shrink its volume. The hydrogel can be restored to its original volume by allowing it to cool and re-swell. In the microfluidic device volume reduction of the hydrogel allows fluid to flow through a channel and in the lens structure volume change relates to a change in focal length.

Applications

- Actuators for use in tunable lenses, microfluidic devices and artificial irises

Key Benefits

- Light responsive over a broader spectrum (all infrared vs. near infrared only)
- Faster response time
- Up to three times greater water uptake as compared to conventional hydrogels
- More efficient hydration-dehydration transition within the hydrogel network

Stage of Development

The composite hydrogels (GO-GMA) have been synthesized.

Additional Information

For More Information About the Inventors

- Hongrui Jiang

Related Technologies

- See WARF reference number P05131US for a method of using hydrogels to make microlenses with adjustable focal lengths.

Publications

- Lo C., Zhu D. and Jiang H. 2011. An Infrared-Light Responsive Graphene-Oxide Incorporated Poly(N-isopropylacrylamide) Hydrogel Nanocomposite. Soft Matter. 7, 5604.

Tech Fields

- Analytical Instrumentation, Methods & Materials : Microfluidics
- Analytical Instrumentation, Methods & Materials : Optics
- Materials & Chemicals : Polymers

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867