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Photoresponsive Polymer-Coated Optical Fibers for Chemical-Free Water Treatment

Background

In recent years, photoresponsive polymers have been considered for many applications from drug delivery to environmental sensors. Photons of light actuate the structure of these folded polymers, providing a means to control their opening and closing. Although various other types of stimuli can be used to activate polymers—including pH, temperature, electric, magnetic fields, and ultrasound—light has numerous advantages for water treatment. Light is noninvasive, convenient, and allows for high temporal control. This mechanism and rationale can likewise be applied to water treatment for light-mediated trapping of pollutant chemicals from water onto the polymer, as well as their release by the reverse process. Hence, light-mediated photoresponsive polymers offer a new form of contaminant reduction that can be incorporated with recent water treatment advancements that use coated optical fibers for efficient light delivery.

Invention Description

Researchers at Arizona State University and the University of Texas at El Paso have developed an integrated photoreactor design containing photoresponsive polymer-coated fiber optics that can purify water or recover precious metal or anions from the water. Visible or UV light launched from the fiber optic core undergoes refraction on the fiber edge, which is coated with photoresponsive polymers. When the light is on, the polymer adsorbs chemical pollutants from a flowing stream of water. When the water flow and light are turned off, the polymer changes to its original configuration and releases these ions, which can then be flushed away or collected. This cycling of flow and light thus allow semi-continuous treatment of water.

Potential Applications

- Water purification
- Water softening
- Recovery of precious metals and anions from water

Benefits and Advantages

- Uniquely integrates advancements in optical fibers and photoresponsive polymers
- Compatible with multiple light sources (sunlight or light-emitting diodes (LEDs))
- Compact size with small footprint
- Accommodates a variety of photoresponsive polymers through tunable optical fibers
- Recovers contaminants non-destructively and without chemical treatments
- Can replace ion-exchange polymer methods and does not require high-strength salts or pH variations to adsorb/desorb ions

Laboratory Homepage of Professor Paul Westerhoff