Removal of multiple contaminants from water by supported ionic liquid phases

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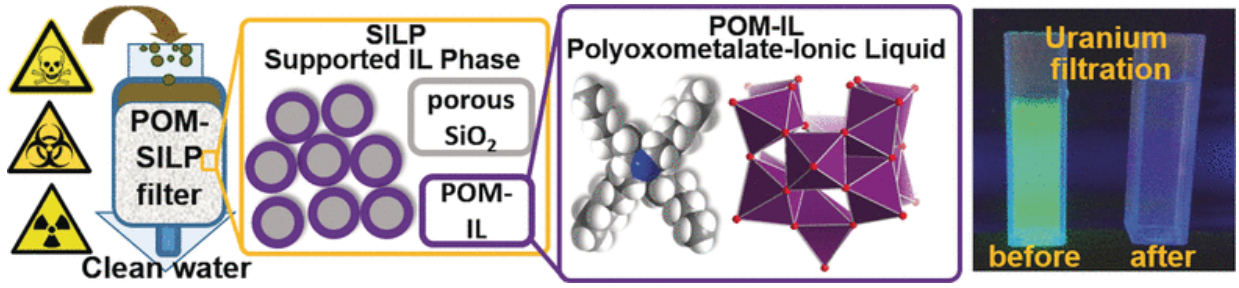

Credit: Wiley

Fresh, clean water coming directly from the tap is a true luxury. In developing countries, people often have no choice but to use a contaminated river for drinking water. Water filters can help by quickly converting polluted surface or ground water into safe drinking water. In the journal Angewandte Chemie, researchers have now introduced a novel multifunctional composite material that removes inorganic, organic, radioactive, and microbial impurities from water.

Usually, water purification involves a series of filters, each designed to remove a single type of impurity. In contrast, this new filter material is an all-rounder. Scientists from the Universities of Ulm (Germany) and Zaragoza (Spain) have now seized upon a relatively new approach for designing materials, which allows molecular components to be

assembled into multifunctional composites called SILP materials (supported ionic liquid phases). An ionic liquid is a salt that is melted at room temperature, making it liquid without being dissolved in a solvent. When such an ionic liquid is adsorbed onto a solid substrate it forms a solid composite material with properties that can be selectively tuned through chemical modification.

The researchers led by Scott G. Mitchell and Carsten Streb have now produced the first SILPs based on polyoxometallates (POM). POMs are molecular transition metal-oxygen clusters in which the metal atoms are bridged by oxygen atoms to form a three-dimensional network. For the new filter materials, they selected polyoxotungstate anions. These anions have a binding site which can trap heavy metal ions. The counterions they selected are voluminous tetraalkylammonium cations known for their antimicrobial effect. The resulting ionic liquids are hydrophobic, immiscible with water, and form stable thin layers on surfaces. By using a porous silicon dioxide support, the researchers obtained dry, free-flowing powders that are easy to transport and handle.

In laboratory experiments, the anions of the new composites reliably removed lead, nickel, copper, chromium, and cobalt ions. Radioactive uranium in the form of UO22+ was trapped directly by the silicon dioxide support. Similarly, the water-soluble blue trityl dye commonly used in the textile industry was also removed as a result of the lipophilic character of the ionic liquid. The antimicrobial cations effectively halt the growth of E. coli. bacteria.

The researchers hope that their new "POM-SILP" filter materials will form the basis for the development of contaminant-specific chemically designed filter systems that can be used for the reliable purification of water in remote areas and developing nations, as well as after natural disasters and chemical accidents.

More information: Sven Herrmann et al. Removal of Multiple Contaminants from Water by Polyoxometalate-Supported Ionic Liquid Phases (POM-SILPs), *Angewandte Chemie International Edition* (2017). DOI: 10.1002/anie.201611072