Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

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Case ID:M22-026P
Published: 10/12/2022

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Solutions and Gels of One-Dimensional Metal Oxides

-Background

Polymeric materials have extensive uses in modern technology, including advanced coatings and paints, plastics, and materials for manufacturing. While organic-based polymers are common, inorganic polymers, especially those based on metal oxides, are quite rare. Materials and processes with properties similar to organic polymers include sol-gel materials and sol-gel processes. Sol-gel technology is one of the most important technologies in the industry which provides vast amounts of inorganic oxides including silica and ceramics. Amorphous silica (SiO_2) is a type of metal oxide that is prepared extensively via sol-gel processes and is now one of the most widely used materials in the world.

Sol-gel processes are a complex phenomenon and experimental conditions for sol-gel processes (precursors, concentration, acidity, temperature, nature of the ions, etc.) have to be chosen carefully. In a sol-gel process, a molecular precursor for a targeted metal oxide is first dissolved in water to form a solution of molecular species. Subsequently, the molecular species polycondensate forms a sol or gel either due to their potency of polycondensation or due to their polycondensation triggered by a change in chemical environment.

Invention Description

Researchers at Arizona State University have discovered early transition metal oxide compounds containing molecular wires that are directly soluble in water or organic solvents. During the process, the bulk crystals are dissolved but the nanostructures are maintained. The resulting product is an inorganic analog of an organic polymer solution or gel. Once dissolved, the nanostructures can be precipitated out using a variety of techniques which produce inorganic-organic hybrid materials.

Evaporation of the solvent from the solution can further concentrate the solution or transform the solution to a gel. Further evaporation of the solvent from the gel can lead to a dry gel.

Potential Applications

- Polymer nanocomposites
- Anticorrosion materials
- Antimicrobials
- Flame retardants
- Catalysis
- Electrochromic device fabrication

Benefits & Advantages

- Simpler implementation
- Diversity & uniqueness in precursors or solvents to choose from
- Fast & efficient isolation of nanostructures using only water or organic solvents

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