Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

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Sol-Gel Synthesis of the V2PC MAX Phase

Background

Sol-gel chemistry is a well-known technique that allows for shape processability of target phases, and can be used for the formation of metal oxide and ceramic nanoparticles. Sol-gel chemistry involves dispersing metal ions that are derived from water soluble precursor salts throughout a semi-solid matrix. This allows for assured homogeneity and can be followed by carbo-thermoreduction of oxidative species if non-oxide products are targeted. However, the variability offered by sol-gel chemistry is not offered in traditional solid state synthesis routes. MAX phases are metallic ceramics/ceramic metals that exhibit a plethora of useful properties, such as high-temperature stability and good electronic/thermal conductivity. Sol-gel chemistry can be used to create thin films, microspheres, and wires.

V2PC is a phosphorous-containing compound that is a member of the MAX phase family, and is typically synthesized in the solid state at very high temperatures using elemental or binary precursors. It typically requires handling elemental (red) phosphorous, which can pose health risks to those handling it as well as environmental hazards. Phosphoric acid, on the other hand, is a low-cost, weak acid that is often used in the food industry at very dilute concentrations. Industrial grade versions of phosphoric acid (85% weight) are benign with proper handling. Since phosphoric acid is sold as a liquid, it is much easier to use when targeting implementation into sol-gel chemistry.

Invention Description

Researchers at Arizona State University have developed a novel method for sol-gel-based synthesis of V2PC through the use of phosphoric acid as a starting material. This method replaces elemental phosphorous, which can be dangerous to handle, with phosphoric acid, a low-cost and commonplace compound in many laboratories. Phosphoric acid is extremely water soluble and is commonly used in the food industry. This method enhances ease of synthesis, which provides the ability to be scaled up as well as improved handling safety.

Potential Applications

- Phosphoric compound shaping (e.g., thin films, spheres, microwires)
- Sustainable & green phosphorous chemistry

Benefits & Advantages

- Lower cost synthesis
- Abundant availability of phosphoric acid
- Non-toxic & relatively benign method (safer handling)
- Easy integration into sol-gel synthesis (liquid form of phosphoric acid)

- Extremely water soluble (easily dispersed throughout gel matrices)

Related Publication: Sol Gel-Based Synthesis of the Phosphorus-Containing MAX Phase V2PC