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Solvated Metal Particle-Coating System and Method

A coating method that deposits reactive metal shells on particles to improve ignition, specific impulse, and in some cases produce zero-carbon emissions.

Researchers at Purdue University have developed a combustion system consisting of solvated metal additives coated on metal particles. With the emergence of climate change, a transition away from fossil fuels is needed. However, energy storage systems, which are especially important for the transition to renewable energy, and certain propulsion systems are inefficient. The use of metal and metalloid particles as fuel sources has found some success in both energy storage and propulsion applications; however, due to inhibiting oxide layers on the surfaces of the particles, their performance is severely limited. The Purdue researchers' system consists of highly reactive metal additives solvated in an outer-sphere electron transferring solvent and coupled with oxide-inhibited metal particles. After dissolution of the highly reactive metal additives, the solvent is evaporated, leaving the reactive metal additives coated on the inhibited metal particles. This highly reactive metal coating can promote ignition of the inhibited particle by disrupting the inhibiting oxide layer at much lower temperatures. By dissolving the highly reactive metal additive in the solvent, it is capable of more fully coating the inhibited particles with a reactive shell. This provides a combustion system with enhanced specific impulse and lowered ignition delay times compared to other similar combustion materials in certain circumstances. Additionally, in certain circumstances, the combustion system produces zero carbon emissions.

Technology Validation: At higher oxidizer-to-fuel mass flow ratios, the combustion system outperformed hydrazine and ammonia, other known combustion materials.

Advantages

- Less toxic than known combustion materials

- More efficient and energy dense than known combustion materials

Technology ID

2022-SON-69837

Category

Chemicals & Advanced Materials/Coatings, Adhesives & Sealants

Semiconductors/Devices & Components

Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

Further information

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View online

- Fossil-fuel alternative

Applications

- Energy storage and generation

- Propulsion systems

TRL: 3

Intellectual Property:

Provisional-Gov. Funding, 2022-06-02, United States

Utility-Gov. Funding, 2023-06-02, United States

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