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Implementation of Microencapsulated Fuels in Combination with Hydrogen Peroxide for Creation of New Monopropellants

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Abstract

In space propulsion, usually monopropellant or bipropellant propulsion systems are used. Bipropellant systems typically have higher specific impulses than monopropellants. But they also require technically complex equipment. Whereas monopropellant systems are used, when simple, reliable and low-cost systems are required. However, monopropellants have the disadvantage of having a lower specific impulse than bipropellants. [1] Consequently, a creation of a monopropellant with the specific impulse of typical bipropellants would be favorable. Since oxidizer and fuel are usually non-miscible and would together form an explosive mixture, they cannot be stored in the same container. This makes it therefore unlikable to create a monopropellant out of typical bipropellant components.

Microencapsulation could be a promising method to enable storage of both fuel and oxidizer in the same tank. For this approach, one of the two components is enveloped by a membrane, segregating oxidizer and fuel. This could improve the miscibility of the two components while making its storage safe. This system would be superior to ordinary monopropellant and bipropellant systems since it combines the advantages of both monopropellants (decreased hardware) and bipropellants (higher specific impulse than common monopropellants).

In this context hydrogen peroxide should be utilized as green and sustainable oxidizer component. [2] As fuel, liquid and hydrophobic organic materials like alkanes or aromatic compounds are enveloped by suitable capsule materials. These fuels have the advantage of being easy to handle, possessing a low risk of hazard and a high energetic content. In addition to that, the vapor pressure of the fuel is reduced, improving safety in terms of both flammability and toxicity.

In previous work of our group, polyamide was identified as a suitable capsule material and interfacial polymerization as a feasible synthesis route. With this experimental approach, non-polar hydrocarbons were encapsulated. The properties of the obtained capsules were characterized using standard analytical methods (thermogravimetry, infrared spectroscopy, optical and electronic microscopy) and studied further with respect to the formation of a monopropellant in combination with hydrogen peroxide as an oxidizing agent.

References

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