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Evaluation of the Specific Ignition Delay Time for the DMAZ with Nanoparticles for the Rocket Engine

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Hydrazine, monomethyl hydrazine (MMH), and unsymmetrical dimethyl hydrazine (UDMH), either individually or in combination, have been widely utilised in space programmes [1]. The utilisation of hydrazine-based fuels presents a significant peril to the well-being of individuals engaged in the handling, storage, and conveyance of said fuels, due to their acute toxicity and potential carcinogenic properties. As a result, it is preferable to substitute them with alternative hypergolic liquid fuels that exhibit comparable ignition and combustion performance, but are not carcinogenic and possess significantly lower toxicity levels than hydrazine-based fuels [2].

Numerous studies have been conducted in the pursuit of viable alternative hypergolic fuels. Notably, amine azides have garnered significant interest in this regard. One example of a representative amine azide is DMAZ, which stands for dimethyl amino ethyl azide. According to the LD50 acute toxicity, DMAZ exhibits approximately thirty times lower toxicity than MMH. Additionally, DMAZ outperforms MMH in various other performance measures [3].

Dimethylaminoethyl azide, sometimes known as DMAZ, is an excellent alternative to the hydrazine group in the aerospace sector. However, with the liquid oxidizer, white fuming nitric acid (WFNA), it has a reasonably long ignition delay period, and it is nonhypergolic when used in conjunction with inhibited red fuming nitric acid (IRFNA). In this study, the ignition delay periods of DMAZ were reduced by the incorporation of several nanoparticles, including metal oxide (including Fe, Zr, B, Al, Cu, and Ce), carbon nanostructures, multi-walled carbon nanotubes (MWCNT), graphene, and graphene oxide without surfactant. According to the findings, the ignition delay time of DMAZ was reduced from 90 milliseconds to just 11.9 milliseconds when ϒ-Al_2O_3 was added.

Keywords: Metal Oxid, Nanoparticles, ϒ-Al_2O_3, DMAZ.

References

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