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Characterizing HMX/AP Cocrystal Propellant Through Planar Laser Induced Fluorescence

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ABSTRACT

Energetic cocrystals, or energetic materials that consist of two or more components that form a unique crystalline structure with unique properties, are currently being investigated as a possible method for decreasing the sensitivity of high energy density explosives for use in powerful solid composite propellants. Fuels more powerful than those in current use have not been practical because of their increased safety hazard due to higher sensitivity to being ignited. This has been one of the barriers that has prevented solid composite propellants from seeing significant improvements in performance. This study is an attempt to characterize a cocrystal of HMX and ammonium perchlorate (AP) of 2:3 molar mass ratio. The cocrystal was compared to the equivalent physical mix and baseline propellants of HMX and AP. Planar laser induced fluorescence (PLIF) was performed to measure hydroxyl (OH) concentrations in the propellants' flames. It appeared that the flame structure of the cocrystal was very similar to that of HMX, as well as the distribution of OH concentrations around the flame. The results were inconclusive, and it is believed that the cocrystal's constituents were not sufficiently bonded at the molecular level; thus, the cocrystal was instead more a mixture of smaller individual crystals of HMX and AP. Future research could include cocrystals created by varying methods, and perform cyano (CN) PLIF to characterize these cocrystals, which may display a better defined region of interest in the flame that can be more closely studied and answer more questions.

KEYWORDS

Cocrystals, propellants, energetic materials, PLIF