Pulsed Motor Firings

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Abstract: Combustion stability additives like zirconium carbide (ZrC), **aluminum oxide** (Al2O3), and zirconium ortho-silicate (ZrSiO4) have long been known to suppress combustion instability in reduced smoke, composite propellant solid rocket systems. Often, as little as 0.5% additive can stabilize an otherwise unstable rocket motor. The additives appear to have effects on both linear and nonlinear pulsed instabilities. Although several theories have been proposed, the actual mechanism on how stability additives work remains unknown. The common belief that additive particle damping alone stabilizes rocket motors is not true. Somehow, the additives change the response behavior of the propellant. Past studies have shown that the additive effect is a combination of particle damping and a reduction in the combustion response of the propellant. In the past study, four propellants were studied containing 0, 1, 3, and 5% ZrC. In this study, the 3% propellant used before will be used again, except 3% HMX will be used in one formulation and 3% ultra fine **aluminum** or ALEX will be used in another. The emphasis here is to examine the combustion response changes. This paper will present the results of T-burner response testing and compare the results to past propellants containing additives. The reason for the work is that recent evidence suggests that traditional additives may not work as well when solid motors are operating at higher pressures. In addition, additives like the ones proposed, add energy to the propellant which would be a performance advantage over classical additives like ZrC.

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