

## Combustion Wave Propagation Enhancement of a Nitrocellulose Solid Monopropellant

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### ABSTRACT

Improvement and control of the burning behavior and characteristics of solid fuels promise improved performance of systems ranging from solid rocket motors to microelectromechanical systems. Introducing methods to enhance combustion wave propagation velocities of solid propellants is a crucial step in realizing improved performance in rocket motors that use organic nitrate-based propellants. This work aims to enhance the burning characteristics of solid fuels through the use of thermally guided combustion waves. In order to increase the burning rate of solid nitrocellulose fuel layers, graphite sheets were used as thermally conductive bases in order to substantially improve heat transfer to unburned portions of the fuel. High-speed photography and instrumentation were used in order to measure the combustion wave propagation velocities and behavior of the fuel in variable pressure environments. The use of a highly thermally conductive graphite sheet base resulted in a significant increase in the burn rate of solid nitrocellulose. Solid fuel layer and graphite thicknesses also appeared to affect the burn rate of the solid monopropellant, and an optimal range of thicknesses was determined. The use of a thermally conductive graphite base in the burning of a nitrocellulose solid monopropellant resulted in burning rates that are at least an order of magnitude larger than the burning rate value of bulk nitrocellulose. Such enhanced burning rates may lead to improved performance of solid rocket motors and alternative energy conversion microelectromechanical devices.

### KEYWORDS

Solid monopropellant, nitrocellulose, flame speed enhancement, combustion wave, heat transfer