Tuning the Performance of Energetic Materials via Architected Channels

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Hypothesis

Energetic materials are materials that have tunable performances, produce large exothermic reactions, and have many applications.

Tunability of energetic materials helps us to evaluate the physics behind these combustion reactions.

Research Question: How can patterned designs affect the performance of these combustion reactions?

Experimental Methods

1D Channel Structure

The channel scale of interest is from \( d = 0-500 \mu m \)

High-Speed Microscopic Imaging System

- Frame Rate: 20000 fps
- Imaging size: 2300 \( \mu m \) x 1700 \( \mu m \)
- Resolution: 3.58 \( \mu m/pixel \)

Results

Material Consumption Rate Results

- Films with channels increased the material consumption rate.
- Peak performance achieved with a microchannel gap

Conclusions

1. We confirmed that the combustion performance of the patterned structures is tunable.
2. Microchannels in the structures lead to an increase in burning rate.
3. Macrochannels lead to a decrease in the burning rate.
4. Next steps: Perform more experiments with different channel gaps to get a better idea of the physics.

References