High Performance Core-shell n-Al@PDA-Cu-O Metastabl Intermixed Composites Constructed by Dopamine-directed Crystal Growth

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Abstract: In this paper, we use dopamine to coat n-Al, forming a PDA interfacial binding layer by its self-polymerization. This interfacial binding layer makes it possible to prevent n-Al from further oxidation, and more importantly, functionalizes n-Al with multiple chemical groups. Later, a versatile strategy is reported to construct core-shell n-Al@PDA-Cu-O based on the direction of PDA on the heterogeneous nucleation and growth of $Cu(OH)_2$ and CuO. In comparison with traditional n-Al/n-CuO MICs, obtained n-Al@PDA-Cu-O showed an improved stability, enhanced energy release (2934.83 J g^{-1}) and homogeneous combustion.

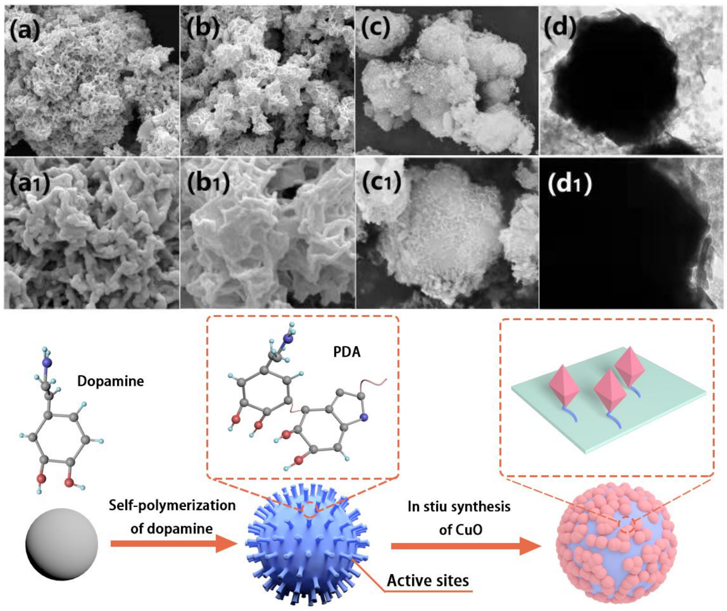

Figure 1. The micrographs of n-Al@PDA@$Cu(OH)_2$ (a, b) and n-Al@PDA@CuO (c, d), and the schematic for the PDA-directed crystal growth of the n-Al@PDA-Cu-O MICs.

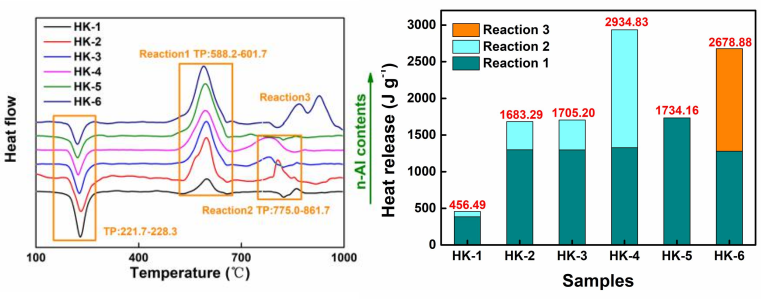

Figure 2. The heaflow curves and the heat release of n-Al@PDA@$Cu(OH)_2$ MICs with different n-Al contents.

Conclusions:

In this research, we have presented a versatile, PDA directed crystal grow strategy for constructing high performance core-shell n-Al@PDA-Cu-O MICs. Obtained MICs showed enhanced energy release and stability in comparison to traditional used n-Al/n-CuO one. To give perspective, the energy release of n-Al@PDA@CuO can reach up to 2934.83 J g^{-1}, while it is only 1341.79 J g^{-1} for the physically mixed one. In addition, the combustion performance was also improved after constructing core-shell composites. And it is promising to realize homogeneous combustion using such core-shell MICs. Those achievements have been reached due to the highly ordered structure and intimately contacted reactants.

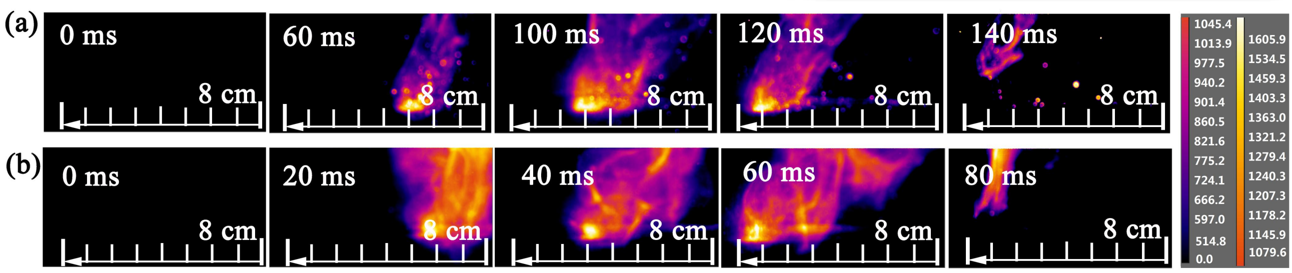

Figure 3. Infrared thermograph results displaying sequential snapshots of n-Al@PDA@$Cu(OH)_2$ MICs (a) and n-Al@PDA@CuO (b).