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Optical Ignition of Nanoenergetic Materials with Tunable Explosion Reactivity

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Abstract : The applications of nanoenergetic materials (nEMs) could be extended by developing more convenient and reliable ignition methods. However, the underwater ignition of nEMs is a significant challenge because water perturbs the reactants prior to ignition and also quenches the subsequent combustion reaction of nEMs upon ignition. In this study, we developed flash and laser-ignitable nEMs for underwater explosion. This was achieved by adding various carbon nanotubes (CNTs) as the optical igniter into an nEM matrix, composed of Al/CuO nanoparticles. The CNTs absorb the irradiated optical energy and rapidly convert it into thermal energy, and then the thermal energy is concentrated to ignite the core catalysts and neighboring nEMs. The maximum burn rate was achieved by adding 1 wt% CNTs into the nEM matrix. The burn rate significantly decreased with increasing amount of CNTs (≥ 2 wt%), indicating that the optical ignition and controlled-explosion reactivity of nEMs are possible by incorporating an appropriate amount of CNTs.

Keywords : nanoenergetic materials, carbon nanotubes, optical ignition, tunable explosion
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