Public Abstract

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Graduation Term:FS 2017

Department:Mechanical & Aerospace Engineering

Degree:MS

Title:Thermal Transport of Nanoenergetics in Composite Materials

When nanoenergetic materials react, they release energy in the form of heat and combustion. Typical applications of nanoenergetic materials include explosives, gunpowder, and various military applications. However, unlike typical explosives such as TNT, nanoenergetic materials possess three times the energy density. When it reacts, the material can reach an adiabatic flame temperature approximately 3000 – 4000 K and generate a shock wave of approximately 2500 m/s. In this work we studied the effects of plasmonic photothermal heating and its interaction with aluminum nanoparticles. By understanding the effects of enhanced electric fields caused by plasmonic gratings, we can study the effects it has on nanoparticles and its applications in in – situ temperature mapping. From the results of this investigation via numerical methods, it was found that six nanoparticles in contact were enough to reach beyond ignition temperature of 743 K, and validated the plasmonic grating does enhance the photothermal heating of nanoparticles.

Another facet to this thesis is the investigation of thermal conductivity of graphene with decorated aluminum nanoparticles. Graphene acts as a great platform for spreading thermal energy due to its excellent thermal properties. We investigate the potentially beneficial thermal properties for sustaining combustion during nanoparticle heating. However, the contact to contact interaction caused by nanoparticles on the surface of graphene is still unclear. This work gives preliminary simulation results and experimental designs to the investigation of the thermal conductivity of graphene with decorated nanoparticles