

Research on off-stoichiometry phenomenon of Al/CuO composites

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Al/CuO composites show the highest pressurization rate where they have slightly more Al than stoichiometric ratio. Several hypotheses are proposed to explain this phenomenon, for example, more Al than stoichiometric ratio is need because excess Al can react with air oxygen. However, proposed hypothesis cannot explain the phenomenon sufficiently and there might be much important factors that result in “Off-stoichiometry”. From X-ray diffraction analysis on combustion products, we observed there are several compounds including unreacted reactant, predicted combustion products, and AlxCuy alloy. Electron microscopy analysis showed remained Al NPs in combustion products have rough surface and are covered with thin Cu layer (~3 nm). The Cu layer deposited on the surface of Al decreases reactivity of Al NPs and suppress combustion propagation. It is predicted that deposition of Cu layer on unreacted Al NPs is prior to combustion wave propagation from temperature profile calculation. From these analysis, we proposed combustion mechanism including deposition of Cu layer on the Al NPs and formation of AlxCuy alloy which cause “off-stoichiometry”.