Volume 15, Number 2, 2006

A New Mechanism for Formation of Spatial Oscillations in SHS of Ni/Al Bilayer Foils

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ABSTRACT

We investigate the self-propagating high-temperature synthesis of Ni/Al foils, in order to gain insight into the mechanisms of combustion and product formation, and to better understand how these products might be used. The study is motivated by the observation of fine spatial oscillations in combusted freestanding foils. Previous researchers have recounted oscillations in the reacted foil parallel to the flame front velocity vector, which they attributed to periodic variation in the flame front velocity. In contrast we report fine-scale spatial oscillations normal to the flame front velocity vector. The reacted foils were further characterized by magnetic force microscopy, atomic force microscopy, and X-ray diffraction. The results are consistent with directional solidification as the mechanism for the formation of these spatial oscillations. Understanding of this mechanism has immediate consequences for modeling the combustion and solidification process, and for utilizing the combustion products.

Keywords: Spatial oscillations, combustion synthesis, nickel-aluminum foils, directional solidification.