

Abstract Submitted  
for the MAR14 Meeting of  
The American Physical Society

**Estimating Atomic Diffusivity in Metallic Multilayered Systems<sup>1</sup>**

MANAV

VOHRA,

OMAR KNIO, Duke University, WEIHS GROUP COLLABORATION<sup>2</sup>, MAO'S GROUP COLLABORATION<sup>3</sup> — Nanostructured multilayered systems can support self-propagating reactions due to exothermic intermixing and small atomic diffusion distances. In the Zr-Al system under stoichiometric and adiabatic conditions, the temperature increases by about 1500 K over ambient as a result of the formation reaction. This usually results in melting in the individual Al layers, and consequently to enhanced rates of intermixing. In order to characterize this phenomenon, and accordingly quantify the associated heat release rates, we rely on transient temperature measurements of homogeneous ignition, as well as measurements of the velocity of self-propagating fronts. The former enables us to infer averaged intermixing rates in a temperature range falling below the melting point of Al, whereas the latter yield estimates at high temperatures. Implementation of the formalism leads to correlations of the atomic diffusivity that exhibit two Arrhenius branches, with a jump across the melting temperature of Al. The resulting composite Arrhenius relation can be readily incorporated into reduced reaction models,<sup>4</sup> and thus exploited to predict transient, multidimensional reaction phenomena.

<sup>1</sup>DTRA Basic Research Award #HDTRA1-11-1-00630

<sup>2</sup>Prof. Timothy P. Weihs and his group at JHU

<sup>3</sup>Prof. Hai-Quan Mao and his group at JHU

<sup>4</sup>M. Salloum and O. M. Knio. *Combustion and Flame* 157.2 (2010): 288-295.

Manav Vohra  
Duke University

Date submitted: 07 Nov 2013

Electronic form version 1.4