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Formation of Ti_5Si_3 and V_5Si_3 by self-propagating high-temperature synthesis and evaluation of combustion wave kinetics

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Abstract

Fabrication of Ti_5Si_3 and V_5Si_3 was conducted by self-propagating high-temperature synthesis (SHS) from the elemental powder compacts of their stoichiometries. Combustion wave kinetics was experimentally studied by measuring the combustion front velocity and temperature, and numerically investigated to determine the Arrhenius factor of the rate function (K_0) and to evaluate the effective thermal conductivity (k_{eff}). Experimental results showed that the 5Ti + 3Si reaction is more exothermic than the 5V + 3Si reaction. With the increase of sample density from 50% to 60% TMD, the flame-front velocity increased from 28 to 50 mm/s for the formation of Ti_5Si_3 and from 6.9 to 8.5 mm/s for V_5Si_3. Based upon numerical simulation and experimental validation, $K_0 = 3 \times 10^9$ s^{-1} and 5×10^7 s^{-1} were deduced for combustion synthesis of Ti_5Si_3 and V_5Si_3, respectively. The ratio of k_{eff}/k_{bulk} increasing from 0.02 to 0.05 was employed in the numerical calculations to simulate the effect of sample compaction density on combustion wave kinetics. Moreover, the measured and

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