COMBUSTION OF THERMALLY COUPLED GRANULAR MIXTURES (Ni + Al)–(Ti + C)

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Abstract: The thermally coupled SHS (self-propagating high-temperature synthesis) processes have been experimentally investigated in a blend consisting of a mixture of Ni + Al and Ti + C granules both in the absence of gas flow and in argon or nitrogen flow. It has been established that ignition of Ni + Al acceptor granules occurs in the combustion front. The values of the burning velocity of the granulated mixture (Ni + Al)–(Ti + C) in a flow of nitrogen exceed the values calculated by the theory of filtration combustion. In the area of low nitrogen flow rates, the burning velocity of the mixture (Ni + Al)–(Ti + C) was shown to increase more rapidly than in Ni + Al and Ti + C mixtures apart at the same flow rates. A mechanism of this increase was explained. The time taken to equalize the temperatures of the donor and acceptor mixtures was measured. It turned out to be significantly less than the cooling time of the entire sample and, therefore, determined by the size of the granules rather than that of the sample. Thus, it has been shown that the use of granular mixture in thermally coupled processes opens up new possibilities for scaling synthesis optimized under laboratory conditions. It has been established that for carrying out thermally coupled reactions in a gas stream, the use of granulated mixtures results in obtaining combustion products in the form of an easily destructible sample. It was shown that the selection of the target product is possible even if the melting point of the product of the acceptor mixture interaction is below the adiabatic temperature of combustion.

Keywords: self-propagating high-temperature synthesis; granulated mixtures; thermally coupled processes; co-current gas flow

DOI: 10.30826/CE19120317

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Received July 16, 2019

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