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Thermal Effect of an External Electric Field on High-temperature Combustion Synthesis

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ABSTRACT

The paper presents a review of the author's publications on Joule energy dissipation by an external electric field during self-propagating high-temperature synthesis (SHS). The formation of a self-generated electric field at the initial stage of oxidizing combustion of single metal particles and this field's contribution to the increase in temperature provided by the chemical reaction is considered in the first part of the paper. A theoretical model showing that such an electrical field may form due to the different diffusion rate of the positive and negative charge carriers through a growing mixed-ionic-electronic conducting oxide shell is presented. The second part concerns thermal effects of the external electric field on the characteristics and stability of a steady-state gasless combustion mode. The electric current action appears to be the most effective at stability limits of the mode. The effects of Joule dissipation by the external field on SHS wave propagation in the spinning mode are discussed in the third part of the paper. The existence of low-temperature (slow) spiral waves with negligible conversion in the spin head is predicted.