Physico-chemical nanomaterials science

Simple methodology for the simulation of self-propagating front in reactive nano-layered foil used for the soldering electronic components

L.A. Olifer[1], V.V. Ivanova[1], G.E. Monastyrsky[1]

[1] National Technical University of Ukraine "KPI". Institute of Physics and Technology, Applied Physics department. Peremohy av. 37. 03056, Kyiv, Ukraine. E-mail: monastyrskygennady@gmail.com

The technology of joining with the aid of self-propagating exothermic reactions in multilayer foils (Nb/Si, Ni/Si, Ni/Al, Ti/Al, Ti/-Si etc) are widely used for the soldering different materials and devices such as metals, alloys, bulk metallic glasses, silicon wafers, MEMS and other microelectronic devices [1,2]. There is a thin edge in such technology of a reactive joining. The properties of foils have to ensure a strong bound between materials but not to overheat electronic components. In order to do the searching of required properties it is convenient to use a computer simulation. Brief survey of the methodologies for the simulation of self-propagating reactions in Ni/Al nano-layered foils as a heat source for the soldering were made. The methods of simulation SHS reactions in nano-layered foils could be divided in 3 categories: 1) very detail simulation based on the mass and heat transfer equations [3]; 2) simplified heat and diffusion model allowing simulate detailed temperature distribution but not the phases [4]; 3) simulating profile of heat output with the aid of DSC curves [1]. In fact not obligatory know exact phases content inside the foils or to simulate oscillatory mode of SHS reaction for the simulation of heat flow through electronic components and solder. It is enough to know only the heat output produced by SHS reaction. That is why the easy-to-use FEM simulation of the moving heat flow inside the sample was developed. Plausible results were obtained, although model is sensitive to the choosing the parameters of the heat distribution inside the foil.

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