Reactive Nanometer Multilayers – A Versatile Tool for Cold Joining

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Abstract
Established joining techniques like welding, soldering or brazing typically are characterized by a large amount of heat input into the components. Especially in the case of heat sensitive structures like MEMS this often results in stress induced deformation and degradation or even damage of the parts. Therefore, there is an urgent need for a more reliable and reproducible method for joining, which is characterized by a well defined and small heat input for only a short time period. So-called reactive nanometer multilayers offer a promising approach to meet these needs.

Reactive nanometer multilayers consist of several hundreds or thousands of alternating nanoscale layers, which can react with each other. Placing a reactive nanometer multilayer between two surfaces already applied with a solder or brazing metal, it can be used as a controllable local heat source. After activating the chemical reaction by an electrical spark, laser pulse or impact, a self-sustaining intermixing reaction starts, which travels the length of the reactive nanometer multilayer resulting in a stable intermetallic material, such as NiAl. The peak temperature of the reaction can be well above 1000 °C, but it only reaches this temperature for milliseconds. Therefore, the heat remains localized in the solder layers while the components remain at room temperature during the entire process. Besides temperature sensitive components reactive nanometer multilayers are also ideally suited to join parts difficult to access.

The talk will present results in the fabrication of reactive nanometer multilayers by magnetron sputter deposition as well as in the fabrication of free standing and presoldered nanometer multilayers. Furthermore, different application examples for this type of joining will be presented.

Figures

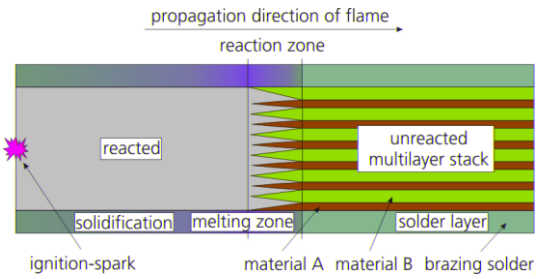

Fig. 1: principle of reactive nanometer multilayers

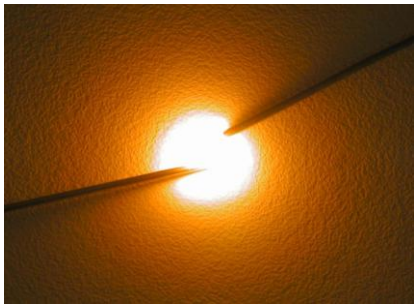

Fig. 2: ignition of a reactive nanometer multilayer by an electrical spark