Topic:

Application of reactive multilayer systems for bonding processes in microsystem technology

Abstract:

In several cooperative projects systematic investigations of the fabrication and application of reactive multilayer systems (RMS) have been performed. In particular, the process technology for reactive bonding aiming at the assembly of micro systems has been demonstrated. RMS have been fabricated by physical vapor deposition and have been provided as foils as well as direct coatings on the bond partners. Alternatively, RMS coatings by electroplating have been demonstrated. Besides the already established Al/Ni-RMS, new reactive materials as Zr/Al/Si, Pd/Sn and Pd/Al have been evaluated for the bonding process. For structuring the RMS chemical etching, lift-off-techniques, and laser structuring have been used on chip-scale as well as on wafer level up to 8 inches. As application examples, where the high thermal conductivity of reactive bonds is very useful, the mounting of Peltier coolers could be demonstrated. Furthermore, silicon-based acceleration sensors showed low mechanical stress after reactive bonding on ceramic substrates.

Further, the dynamics of the bonding process using reactive multilayer systems (RMS) is studied by use of acceleration sensors. A piezoelectric accelerometer with a wide dynamic range was selected to measure the vertical acceleration during the reaction process using a Ni/Al RMS foil. This sensor was integrated into a die bonding tool. Then, bonding experiments were performed with dummy plates and substrates by igniting the RMS and measuring the sensor signal simultaneously. It was found that a strong sensor signal occurs at the time when the reaction of the RMS is completed. By additional cross sectional analysis of the bonding area, the correlation between signal height and total volume contraction has been investigated. The obtained results demonstrate that this experimental setup can be used to find materials and process conditions for bonding with significantly reduced shock-wave, lowering the risk of damage to the assembled device.

Contact:

Dr. Stephan Knappmann

Hahn-Schickard, Institut für Mikro- und Informationstechnik
Hahn-Schickard-Gesellschaft für angewandte Forschung e.V.

Wilhelm-Schickard-Straße 10
78052 Villingen-Schwenningen
Germany

stephan.knappmann@hahn-schickard.de