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Determination of the pressure in a TO vacuum package using a micro Pirani

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Numerous MEMS components such as acceleration sensors, gyroscope sensors, ultrasonic sensors or micro-resonators require vacuum packaging in order to reduce the gas friction of the mechanical moving parts. While these applications work already in fine vacuum, for field emission based electron or X-ray sources, high vacuum is required to avoid ion bombardment and arcing in order to achieve a long lifetime.
We developed a micro Pirani sensor with a measurement range from atmospheric pressure down to 5e-5 mbar to determine and to monitor the pressure in hermetic sealed vacuum packages. This Pirani was mounted on a TO header. Subsequently, the housing was sealed by soldering a cap on the TO header in vacuum atmosphere at 1e-6 mbar. After this sealing process, a pressure in the range of 1e-2 mbar was determined inside the vacuum package with a volume of about 4.5 cm^3. This significant increase of the pressure was attributed to outgassing of the components. For the most MEMS applications, the quality of vacuum sealing is sufficient, but not for encapsulated field emission devices. Therefore, a new TO package with a micro Pirani and an additional getter material was built. After the sealing process, the pressure inside the package was reduced to a pressure below the micro Pirani's resolution limit of 5e-5 mbar by the thermally activated getter.
For the first time, it was possible to measure such a small pressure in a hermetically sealed TO package.TO vacuum packages as well as packages on wafer-level can be further optimized by using this method of determining and monitoring the pressure. In the next step, the measurement range of Pirani sensor will be further extended in order to measure the total pressure achieved by the getter material.

Author: Mr LANGER, Christoph (Faculty of General Sciences and Microsystems Technology, OTH Regensburg)

Co-authors: Mr POPP, Patrick (Ketek GmbH); Mr LAWROWSKI, Robert (Faculty of General Sciences and Microsystems Technology, OTH Regensburg); Ms JAKŠIČ, Jasna (Ketek GmbH); Dr DAMS, Florian (Ketek GmbH); Mr DÜSBERG, Felix (Ketek GmbH); Dr BACHMANN, Michael (Ketek GmbH); Dr PAHLKE, Andreas (Ketek GmbH); Prof. SCHREINER, Rupert (Faculty of General Sciences and Microsystems Technology, OTH Regensburg)

Presenter: Mr LANGER, Christoph (Faculty of General Sciences and Microsystems Technology, OTH Regensburg)

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