**Combined vacuum gauge based on MEMS pressure sensors**

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Topic: A3 Vacuum Microelectronic and Nanoelectronic Devices
Preferred Presentation Form: O Oral

## ABSTRACT

Vacuum processes are widely used in all fields of industry. As in other fields of technology, the trend in vacuum measurement is towards miniaturization using MEMS. The straightforward way of measuring pressure as force per area (e.g. by measuring the deflection of a thin silicon membrane) is independent of the process gas species. However, this direct measurement principle is restricted to a pressure range greater than approx. 1 mbar due to the limited sensitivity of the MEMS membrane, given by its thickness and area. For lower pressures, only indirect methods are available. By measuring the thermal conductance of the residual gas (Pirani sensor) a lower pressure limit of approx. $10^{-5}$ mbar can be obtained, which is sufficient for a wide range of applications [1]. However, due to the indirect method, the output signal of these sensors depends on the process gas in the chamber. The influence of the gas species on the output signal of a MEMS Pirani sensor can be significantly reduced by an automated calibration procedure based on a curve fitting in the overlap region of the two measurement ranges during evacuation [2]. A sensor system consisting of a MEMS membrane and a MEMS thermal vacuum sensor was fabricated and assembled in a TO package. By using an in-system software calibration method for gas species correction, the sensor system combines the advantage of a membrane sensor (gas species independent signal) with the wide measurement range of up to 8 orders of magnitude of a thermal vacuum sensor. This sensor system allows pressure measurement over the complete measurement range almost independent of the actual chamber gas composition. Compared to standard correction techniques [3] the knowledge of the composition of the gas mixture is not required. This allows the realization of compact and accurate vacuum sensor systems for a wide range of applications.

## References

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