

Calibration of micro Pirani vacuum gauges for internal pressure measurement in miniaturized vacuum chambers

P. Coste¹, F. Parrain¹, A. Bosseboeuf¹, C. Bessouet¹, J. Moulin¹ and Y. Jang²

Center for Nanoscience and Nanotechnology (C2N), University Paris Saclay, CNRS, 10 Boulevard Thomas Gobert, 91120 Palaiseau, France.

Nextron Corporation, Room 609, V1 Tower, 273-20 Geejwa-Ro, Geumjeong-Gu, Busan, 46257, South Korea

Miniaturized vacuum chambers typically have vacuum feedthroughs and fittings with a low and poorly known conductance, a rather high and variable outgassing rate, and often, non-negligible leak rates. Consequently, the internal pressure is difficult to estimate with a good accuracy from the usual external pressure measurement, notably when in situ heating/cooling is performed or when a gas is injected. To solve this issue, one or several micro Pirani gauges [1, 2] can be integrated inside the chamber for direct internal pressure measurement, at least in the 10^{-4} mbar to a few hundreds of mbar range. In order to calibrate such micro Pirani gauges and overall their gas dependencies, we specifically developed a vacuum set-up equipped with three high accuracy (0.5%) absolute capacitance gauges, a dedicated electronic card with a 16 bits AD converter, and an acquisition/calibration software. These tools were used for the calibration at 21°C of the response in N_2 (Fig.1) and the gas dependencies in a large pressure range (Fig.2) for Ar, H_2 and ambient Air (Rh=40%) of HVS Vac03k and Vac04 micro Pirani sensors in TO39 package from Heimann™ company [1]. The gas dependency below ~ 1 mbar is close to results reported by K. Jousten [3] for macroscopic Pirani gauges but with a larger discrepancy for H_2 than for Argon (Fig. 2.). At higher pressure, the responses for Ar and H_2 rapidly diverge from N_2 response and are also drastically different from macroscopic Pirani gauges. The Air pressure differs significantly from N_2 pressure only beyond a few mbars. Future works will investigate the case of other gases and the effect of temperature.

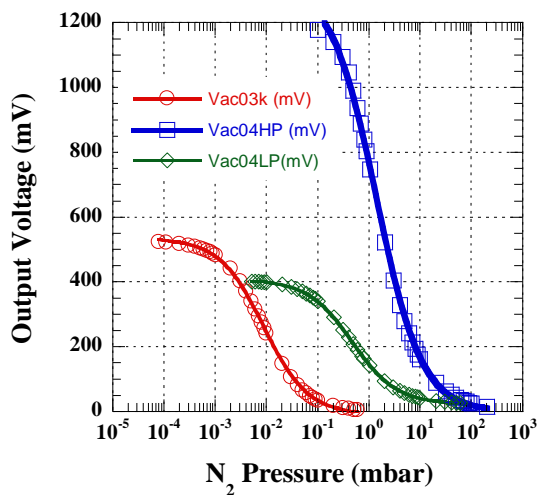


Fig.1 MicroPirani sensors response in N_2 with fits by $V=a[P/(1+b.P) +c]$ function.

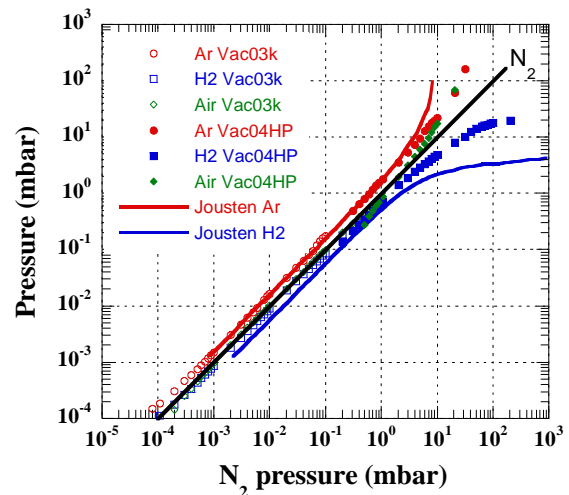


Fig.2 Gas dependencies of microPirani sensors. (true pressure vs N_2 equivalent pressure).

References

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