

SRS Tech Note

BGA244 Long term stability for measurement of Trimethylindium

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Introduction

Trimethylindium (TMI) is used as a precursor for metalorganic vapor phase epitaxy (MOVPE) or metalorganic chemical vapor deposition (MOCVD) processes. A carrier gas, usually nitrogen or hydrogen, is bubbled through the liquid TMI at a controlled temperature. The vapor pressure of TMI in the gas leaving the bubbler depends on the flow rate and (exponentially) on the TMI bath temperature. A TMI concentration monitor is often used to verify the amount of TMI leaving the bubbler and flowing into the reaction chamber.

BGA244 as a TMI concentration monitor

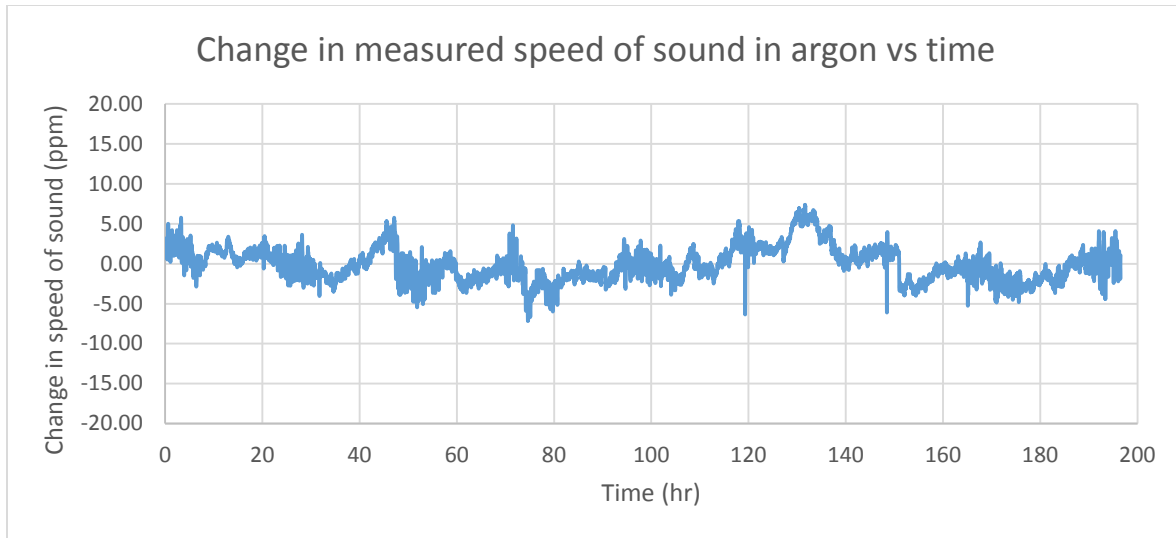
The BGA244 Binary Gas Analyzer can be used as a TMI concentration monitor. The BGA244 determines the TMI concentration by measuring the temperature and speed of sound of the gas leaving the bubbler. TMI, with a molecular weight of 160 g/mol, can be detected with the highest sensitivity in hydrogen and with good sensitivity in nitrogen or argon. An important figure of merit is the stability of the TMI concentration measurement, which depends on the stability of the speed of sound measurement in the BGA244.

Experiment

A BGA244 was filled with argon at 1 atmosphere and closed off. The BGA244 was operated with its cell heaters set to 35 C so as to reduce variations due to the changing room temperature (which changed by about ± 1.5 C). The speed of sound and the concentration of TMI were recorded over eight days by the BGA244 Windows© program, BGA-Mon. The exported comma separated files were analyzed with Excel.

Results

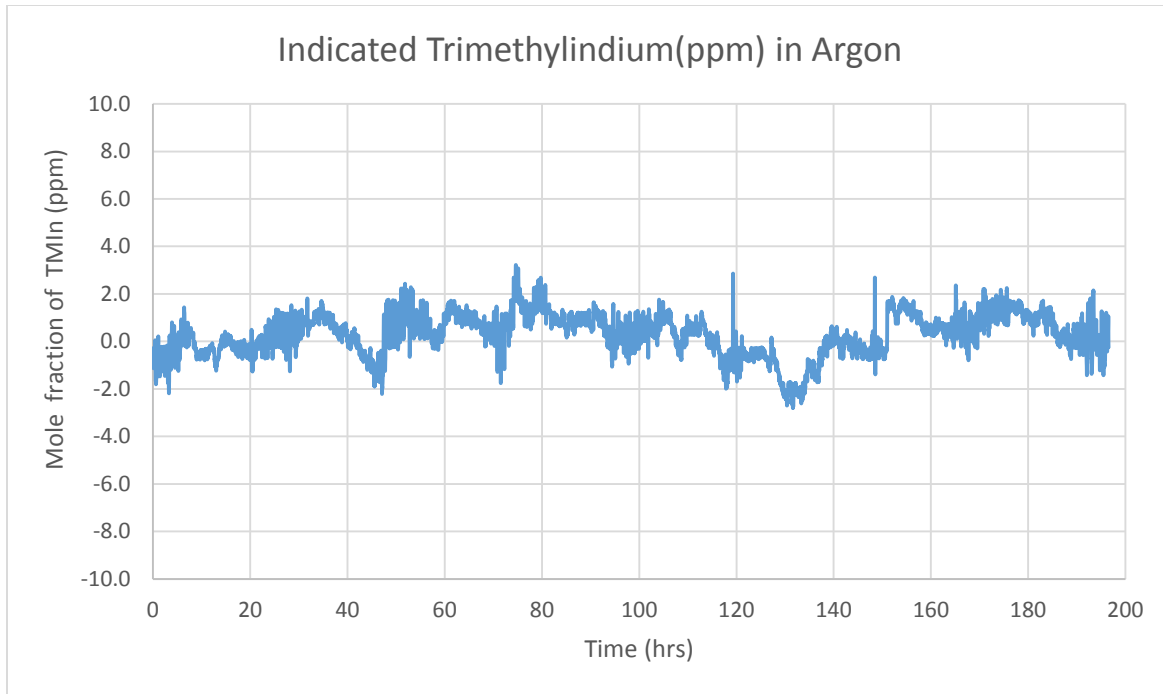
The graph below shows the wander in the measured speed of sound over an eight day period. The peak excursions in the speed of sound were about ± 7 ppm.



Indicated TMI concentration

The BGA244 firmware has thermodynamic data for about 500 liquids and gases (including TMI, N₂, H₂ and Ar) which allow it to determine the composition of binary gas mixtures. The BGA244 was setup to report the concentration of TMI in argon. Of course there was no TMI in this experiment, and so the reported values represent the noise in the measurement of TMI.

The graph below shows the indicated mole fraction of TMI over the eight day period. The peak deviations were about ± 3 ppm, with an rms deviation of about 1 ppm. Variations were correlated to changes in room temperature only. (There was no apparent ageing.) The BGA 244 is also entirely immune to changes in atmospheric pressure.



Conclusion

The BGA244 can be used as a concentration monitor for MOVPE/MOCVP precursors. Best case results (as all conditions, except for room temperature, were very well controlled in this experiment) show a long term stability of ± 3 ppm with no measureable ageing.