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Development of accurate dimethyl sulfide primary standard gas mixtures at nanomole per mole levels for ambient measurement

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Dimethyl sulfide (DMS) emitted from the oceanic phytoplankton is the major natural sulfur source in global scale. Ambient DMS plays important roles in climate change and atmospheric chemistry as a precursor of sulfate aerosols. In this regard, DMS over the marine atmosphere is monitored in global network and reported at several hundred picomole per mole levels. However, their measurement uncertainty is too high for monitoring long-term trends of DMS and thus necessary to be improved for better understanding of the role of DMS in atmospheric chemistry. Accurate and stable DMS standards are essential for the precise measurement of ambient DMS since the uncertainty of the standards is one of the main uncertainty for the measurement data quality. Gravimetrically prepared gas standards in cylinders are widely used because of their traceability and portability. To maintain the accuracy, assessment of stability of gas standards in cylinders is important especially for reactive gases such as DMS. A primary standard gas mixture (PSM) is the top of the pinnacle of standards, therefore both preparing and maintaining the accurate mole fraction of PSM is essential to distribute accurate standards. In this study, DMS PSMs at nanomole per mole levels were prepared in cylinders with different internal wall treatment to develop stable DMS PSMs in the optimum cylinder. Short-term stability of DMS PSMs was checked using equal division method. And then long-term stability of DMS PSMs was assessed by tracking the ratios of DMS to internal standards. The gravimetrically determined mole fractions of DMS PSMs at nanomole per mole levels were analytically verified and consistent within their uncertainties.