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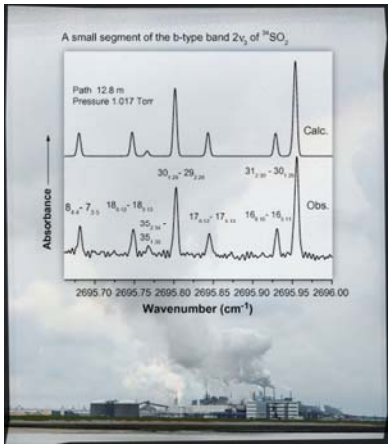
EMSL Science Made Possible

Seeing Inside Sulfur Dioxide

EMSL spectrometer, expertise provide details on harmful pollutant

Using resources at the Department of Energy's EMSL, an international team completed a detailed infrared spectral analysis of $^{34}S^{16}O_2$. This analysis of this lesser studied sulfur isotope allows researchers to more accurately quantify the total amount of sulfur dioxide in the atmosphere. Measuring the ratio $^{34}SO_2$ and $^{32}SO_2$ may provide insights into discerning between specific natural and human-made sources of sulfur dioxide that contributes to, for example, acid rain. With infrared spectroscopy, atmospheric sensing can be done over meters to many kilometers, from the ground, a balloon, aircraft, or a satellite. Team members were from the National Institute for Standards and Technology, Laboratoire Inter-Universitaire des Systemes Atmosphériques in France, University Cheikh Anta Diop in West Africa's Senegal, and Pacific Northwest National Laboratory. The team began by studying the isotopic sample using EMSL's high-resolution Fourier transform infrared spectrometer. After a preliminary analysis, additional analysis was done at NIST. The analysis revealed new information about the structure of the molecule, the rotational and vibrational energies of the molecule, and the interactions of these energies within the molecule. This work also measured, for the first time, the infrared absorption cross-sections for individual rotational-vibrational transitions of $^{34}S^{16}O_2$, vital for eco-monitoring.



EMSL users obtained detailed data on the industrial pollutant $^{34}SO_2$.

Scientific impact: This study provides a more accurate experimental view of the structure, bonding, and vibrational and rotational energy patterns of $^{34}S^{16}O_2$. The results provide detailed information about the potential energy surface of a molecule with a modest number of electrons. This work is part of EMSL's ongoing efforts to characterize molecular structures with unprecedented resolution.

Societal impact: Acid rain and respiratory problems are related to sulfur dioxide emissions from coal-fired power plants, volcanic eruptions, and other sources. To design cost-effective sulfur dioxide remediation tools and to effectively regulate emissions, scientists must be able to monitor sulfur dioxide at specific sources and in the atmosphere. The infrared cross-section values of $^{34}S^{16}O_2$ allow field measurements to be done with greater accuracy and source discernment.

For more information, contact EMSL Communications Manager Mary Ann Showalter (509-371-6017).

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