Abstract Submitted
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Toward quantitative acoustic molecular gas sensing ANDI PETCULESCU, University of Louisiana at Lafayette — Laser spectroscopy techniques provide unrivaled tools for detailed molecular sensing studies. Critical applications such as gas monitoring in life-support systems often require sensors that are not only fast and sufficiently accurate but also rugged and not needing extensive maintenance and calibration. Acoustic sensors are widely used to this end, based on measuring sound speed changes. These, however, can only constrain the overall molecular mass. For reasons unknown, researchers have habitually disregarded acoustic attenuation. Beside the classical sound loss mechanisms due to viscosity, heat conduction, and diffusion, the non-classical contribution to attenuation arises from the inability of internal molecular degrees of freedom to follow the acoustic temperature fluctuations. This connects acoustic attenuation to the molecular relaxation times. In the laboratory, acoustic studies of molecular relaxation in fluids require that the ambient pressure be varied over a wide range at a given frequency in order to cover the relaxation processes. In a fast-sensing device, this would be highly impractical. A novel algorithm is presented here relying on measuring sound speed and attenuation at one pressure and two frequencies to reconstruct the full frequency dependence of the effective specific heat for the main relaxation processes. This would enable a smart sensor to infer the concentration and nature of contaminant molecules in a base gas.

Andi Petculescu
University of Louisiana at Lafayette

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