Infrared spectroscopy studies of perovskite oxides at high pressures

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Abstract

Phonon studies are fundamental to the understanding of the physics at play in perovskite oxides. In the laboratory, Raman and infrared spectroscopies are the most commonly implemented techniques for that purpose; they are now routinely carried out as a function of temperature with (nearly) equal ease. When it comes to high-pressure studies however, they are still unequal. Raman spectroscopy has been overall more easily implemented with diamond-anvil cells and is now routinely performed in the lab or at large facilities up to the Mbar and beyond. In contrast, measuring infrared spectra under pressure *in the phonon range* has been more challenging for a number of reasons, some rather mundane – such as the need for proper references, and some more fundamental – such as the diffraction limit that sets a minimum size for samples and therefore caps the maximum pressure reasonably achievable.

In this contribution, I will provide a summary of several infrared spectroscopy studies at high pressures performed by our group on the AILES beamline at the SOLEIL synchrotron source. Our original motivation, the direct observation of polar soft modes at high pressures has been challenging. However, along the way through many experiments carried out on a number of classical perovskite oxides, ferroelectric or not ($BaZrO_3$, $PbTiO_3$, $KNbO_3$), and other compounds up to a maximum pressure of 70 GPa, we have learnt a number of useful lessons. The antiferrodistortive transition Pm-3m → I4mcm common to so many perovskites and the associated mode activations will be given a particular focus.