Abstract Submitted
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Symmetry Breaking and Friction in Phosphorene[1] JASON CHRISTOPHER, Boston University, STEVEN KOENIG, National University of Singapore, ANGELO ZILETTI, Boston University, BO WEN, HAN ZHENG, CORY DEAN, Columbia University, OZYILMAZ BARBAROS, National University of Singapore, ANNA SWAN, BENNETT GOLDBERG, Boston University — Strain in 2D crystals tunes material properties, controllably breaking crystal symmetry, and inducing pseudo magnetic fields. Friction plays a central role in these applications because of its effect on the strain field's orientation and magnitude. We have developed a simple experiment for generating known strain fields in 2D crystals to explore phonon response and friction. Our technique utilizes 2D crystals suspended over holes etched in a Si substrate to create sealed micro-chambers. We place these chambers into a pressure vessel with an optical window for Raman measurements while simultaneously applying external pressure. The pressure deforms and slides the 2D material into the hole, and we map out the strained Raman spectra. The Raman active phonons of phosphorene in the backscattering configuration are the A_g^1, B_{2g} and A_g^2 modes. Group theory predicts that these modes are non-degenerate, however as we strain the material we observe peak splitting, which is what is expected only for degenerate modes. This apparent discrepancy can be explained by considering the effect of strain on the Raman selection rules. Under strain the crystal symmetry is broken causing previously Raman inactive modes to become active creating an effect that appears like peak splitting.

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