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Strain sensing through the optical properties of graphene: Comparing indentation of epitaxial- and CVD-grown graphene ERIN L. WOOD, YANFEI YANG, NIST, Gaithersburg, MD, USA, WILL GANNETT, NIST, Boulder, CO, USA, GORDON A. SHAW, RANDOLPH E. ELMQUIST, NIST, Gaithersburg, MD, USA, MARK W. KELLER, NIST, Boulder, CO, USA, ANGELA R. HIGHT WALKER, NIST, Gaithersburg, MD, USA — The unprecedented mechanical and electrical properties of graphene have garnered great interest, yet critical understanding of deformation processes is needed before robust devices are realized. Raman spectroscopy is an information rich, non-destructive probe of mechanical, structural, and electrical properties of graphene through analysis of the prominent bands; D, G, and G'. Previous reports on strained graphene have been largely limited to graphene transferred to flexible substrates and have produced divergent results regarding shifting and splitting in the G band. To systematically evaluate strain, we compare as-grown graphene on either Cu or SiC to the blank substrates which are well understood. Strain was applied by micro- or nano-indentation and Raman mapping was collected of the deformed area providing validation of the applied strain. Confocal Raman microscopy is diffraction limited, however, and localized strain cannot be spatially resolved at the nanoscale. To overcome this, an AFM probe was co-located within the Raman laser focus to obtain sub-diffraction spatial resolution. This also increases the sensitivity to the surface, allowing for observation of the D peak within a micron of nano-indents, which was unseen in confocal Raman spectroscopy.

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