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Complex refractive index of graphene measured by picometrology XUEFENG WANG, DAVID NOLTE, Purdue University — The complex refractive index $\tilde{n}_g$ of graphene remains unresolved because the traditional technique, ellipsometry, fails when applied to graphene with its sub-nanometer thickness, dielectric anisotropy, and small transverse sample size. Here we apply interferometric picometrology to measure $\tilde{n}_g$ at 488 nm, 532 nm and 633 nm. A strong dispersion of $\tilde{n}_g$ was found in the visible region. $\tilde{n}_g$ varies from 2.4-1.0i at 532 nm to 3.0-1.4i at 633 nm at room temperature. The dispersion is five times stronger than bulk graphite (2.67-1.34i to 2.73-1.42i from 532 nm to 633 nm). In experiments, Graphene is deposited on a substrate with complex reflection coefficient $\tilde{r}$ tuned near an antinode condition. As a dielectric film, graphene modifies $\tilde{r}$ of the substrate into $\tilde{r}'$. Picometrology measures both the amplitude and the phase change of $\tilde{r}$, andtherefore acquires the full information needed to calculate $\tilde{n}_g$. This is accomplished by scanning a normal-incidence focused Gaussian beam (1.5 μm width) over the graphene and monitoring the asymmetric diffraction of the reflected beam. Picometrology measures the complex change of $\tilde{r}$ with a quadrant detector that simultaneously monitors both intensity and axis shift of the reflected beam and calculates $\tilde{n}_g$. The strong dispersion of graphene is reported here for the first time, and it is likely caused by the strongly modified quantum level structure of the single atomic layer.

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