Structure and spectroscopic analysis of the graphene monolayer film directly grown on the quartz substrate via the HF-CVD technique

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Abstract

Direct growth of a monolayer graphene film on a quartz substrate by a hot filament chemical vapor deposition technique is reported. The monolayer graphene film prepared was characterized by Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), selected area electron diffraction (SAED), and atomic force microscopy (AFM). The optical properties were studied by spectroscopic ellipsometry. The experimental data were fitted by the Forouhi-Bloomer model to estimate the extinction coefficient and the refractive index of the monolayer graphene film. The refractive index spectrum in the visible region was studied based on the harmonic oscillator model. The lattice dielectric constant, real and imaginary dielectric constants and the ratio of the charge carrier number to the effective mass were determined. The surface and volume energy loss parameters were also found and showed that the value of the surface energy loss is greater than the volume energy loss. The determination of these optical constants will open new avenue for novel applications of graphene films in the field of wave plates, light modulators, ultrahigh frequency signal processing and LCDs. (C) 2016 Elsevier Ltd. All rights reserved.

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