

INTISARI

RANCANG BANGUN *SPECTROSCOPIC ELLIPSOMETRY* UNTUK MENGUKUR KONSTANTA DIELEKTRIK DAN KETEBALAN LAPISAN TIPIS GRAPHENE/SiO₂ MENGGUNAKAN SUMBER CAHAYA PANJANG GELOMBANG TUNGGAL (632,8 nm)

Kiki Megasari

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Telah dirancang bangun sistem pengukuran konstanta dielektrik dan pengukuran ketebalan lapisan tipis graphene/SiO₂ menggunakan prinsip ellipsometri. Prinsip ellipsometri yang digunakan *spectroscopic ellipsometry* (SE) yaitu mengkarakterisasi perubahan beda fase Δ dan rasio amplitudo Ψ antara sinar pantul yang terpolarisasi-p dan -s. Dalam penelitian ini yaitu merancang dan membangun SE menggunakan konfigurasi *Rotating Analyzer Ellipsometry* (RAE) dimana RAE merupakan konfigurasi yang paling sederhana. Pengukuran dilakukan pada tiga sudut yang berbeda yakni 60°, 62°, dan 64°. Hasil dari material uji emas (Au) pada ketiga sudut datang tersebut masing-masing $\tilde{\epsilon}_{60} = -4,3511 + 2,7073i$, $\tilde{\epsilon}_{62} = -4,3929 + 2,5203i$, dan $\tilde{\epsilon}_{64} = -4,1858 + 2,4922i$. Untuk material silikon diperoleh $\tilde{\epsilon}_{60} = -3,8726 - 5,3014i$, $\tilde{\epsilon}_{62} = -4,1024 - 4,2337i$, dan $\tilde{\epsilon}_{64} = -4,4881 - 6,767i$. Pada lapisan tipis SiO₂ didapatkan hasil $\tilde{\epsilon}_{60} = -2,1077 - 3,7117i$ dengan ketebalan 300 nm, $\tilde{\epsilon}_{62} = -2,1926 - 4,4726i$ dengan ketebalan 300 nm, dan $\tilde{\epsilon}_{64} = -1,7559 - 5,4660i$ dengan ketebalan 300 nm. Untuk lapisan graphene/SiO₂ diperoleh hasil $\tilde{\epsilon}_{60} = -4,6883 - 25,8730i$ dengan ketebalan 0,355 nm, $\tilde{\epsilon}_{62} = -6,3927 - 23,9010i$ dengan ketebalan 0,355 nm, dan $\tilde{\epsilon}_{64} = -8,0736 - 22,8704i$ dengan ketebalan 0,355 nm. Cara untuk mengekstrak konstanta dielektrik dan ketebalan menggunakan metode Newton Raphson. Hasil yang tidak sesuai dengan referensi tersebut dikoreksi pada beberapa parameter seperti polarisator, analisator, sudut datang, dan penambahan komponen.

Kata kunci : konstanta dielektrik, *spectroscopic ellipsometry*, Newton Raphson

ABSTRACT

DESIGN SPECTROSCOPIC ELLIPSOMETRY TO MEASURE DIELECTRIC CONSTANTS AND THICKNESS OF GRAPHENE/SiO₂ USING SOURCE LIGHT SINGLE WAVELENGTH (632,8 nm)

Kiki Megasari

13/354930/PPA/04321

The measurement system for determining dielectric constant and thickness of graphene on SiO₂/Silicon substrate using ellipsometry technique has been developed. The basic principle that used in spectroscopic ellipsometry (SE) is to analyze the changes in the phase difference Δ and the amplitude ratio Ψ between *p*- and *s*- polarized reflected light. In this work, the SE configuration that had been used was Rotating Analyzer Ellipsometry (RAE) with He-Ne laser (wavelength = 632.5 nm) employed as a light source. This experiment using single wavelength (632.5 nm) and the angle of incidence at 60°, 62°, and 64°. The value of gold (Au) dielectric constants value obtained at those three incident angles were $\tilde{\epsilon}_{60} = -4.3511 + 2.7073i$, $\tilde{\epsilon}_{62} = -4.3929 + 2.5203i$, and $\tilde{\epsilon}_{64} = -4.1858 + 2.4922i$. And for silicon, the dielectric constants obtained were $\tilde{\epsilon}_{60} = -3.8726 - 5.3014i$, $\tilde{\epsilon}_{62} = -4.1024 - 4.2337i$, and $\tilde{\epsilon}_{64} = -4.4881 - 6.767i$. For SiO₂ with thickness 300 nm, the values were $\tilde{\epsilon}_{60} = -2.1077 - 3.7117i$, $\tilde{\epsilon}_{62} = -2.1926 - 4.4726i$, and with $\tilde{\epsilon}_{64} = -1.7559 - 5.4660i$. Then for graphene/SiO₂, the values obtained with thickness 0.355 nm were $\tilde{\epsilon}_{60} = -4.6883 - 25.8730i$, $\tilde{\epsilon}_{62} = -6.3927 - 23.9010i$ and $\tilde{\epsilon}_{64} = -8.0736 - 22.8704i$. Newton Raphson numerical method was used to extract the dielectric constants and to determine the thickness of the thin film. The results which were not in agreement with the reference must be corrected in some parameters such as polarizer, analyzer, the angle of incidence, as well as the additional optical component.

Keywords: dielectric constants, spectroscopic ellipsometry, Newton Raphson