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Photoacoustic technique for determining optical absorption coefficients in nanostructured silicon

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Silicon nanowires have unique thermophysical and optical properties that suit various applications, including sensors, energy systems, and semiconductor industries. The optical properties of silicon nanowires can vary significantly depending on their synthesis method and the initial parameters of the crystalline material, both of which have a substantial impact on the resulting morphology. Consequently, developing reliable, non-destructive methods for measuring these optical characteristics is a crucial objective.

This report introduces an alternative approach to measuring the optical properties of silicon nanowire arrays with varying morphological characteristics, utilizing the photoacoustic gas-microphone method. The analysis is based on data from optical reflectance measurements performed using an integrating sphere, combined with thermal conductivity data derived from Raman spectroscopy. Light absorption in the samples was examined using photoacoustic methods, where the samples absorbed non-stationary laser radiation at multiple wavelengths within the visible spectrum. The amplitude-frequency dependence of the photoacoustic signal was analyzed, and a theoretical model was applied to approximate the experimental data, yielding values for the optical absorption coefficients of silicon nanowires with different morphologies.

This approach highlights the effectiveness of the photoacoustic method in evaluating the optical properties of silicon nanowires with different morphologies, offering a reliable and non-destructive means of analysis.

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