

Abstract

Thermo-Optical Characterization of PVA Films with SiO₂-Au Nanocomplexes Using Photoacoustic Spectroscopy [†]

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[†] Presented at the 3rd International Online Conference on Polymer Science, 19–21 November 2025; Available online: <https://sciforum.net/event/IOCPS2025>.

Keywords: nanocomplexes; optical absorption coefficient; thermal diffusivity; photoacoustic spectroscopy

Recent progress in nanoscience has enabled the development of nanostructured materials with applications in the diagnosis and treatment of diseases. Among these, silicon dioxide (SiO₂) nanoparticles combined with gold nanoparticles (AuNPs) have demonstrated significant promise in biomedical imaging and photothermal therapy due to their optical tunability and biocompatibility. In this study, SiO₂-Au nanocomplexes were synthesized and dispersed in aqueous polyvinyl alcohol (PVA, from Sigma Aldrich, Saint Louis, USA) solutions to fabricate flexible films that were approximately 200 microns thick. The nanocomposite films were prepared with varying nanoparticle concentrations ranging from 1.50 to 4.5 mg/mL to investigate their optical and thermal behavior. Photopyroelectric (PPE) techniques were employed to determine key parameters such as optical absorption coefficient and thermal diffusivity, which are crucial for assessing their photothermal conversion capabilities. The results indicated that at specific SiO₂-Au nanocomplex concentrations, the films exhibited high absorption coefficients in the visible spectrum, particularly at wavelengths of 520 nm and 660 nm. Their thermal diffusivities were recorded to determine their capacity for light-to-heat conversion. These findings highlight the potential of PVA films with SiO₂-Au nanocomplexes for use in minimally invasive photothermal therapies. Additionally, polyvinyl alcohol provides biocompatibility, ease of processing, and mechanical flexibility, making this nanocomposite system a promising candidate for integration into biomedical devices and therapeutic platforms.



Academic Editor: Alessandro Pegoretti

Published: 14 November 2025

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Author Contributions: C.P.C.: Conceptualization, Investigation, Methodology, Writing—original draft, Writing—review & editing. J.A.B.-L.: Conceptualization, Project administration, Supervision, Validation, Writing—review & editing. Y.S.-F.: Investigation, Visualization, Writing—original draft. A.M.M.-S.: Investigation, Validation, Visualization. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data is contained within the article.

Conflicts of Interest: The authors declare no conflict of interest.

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