

Abstract

Ultrasensitive Detection of Biomarkers Based on Anisotropic Gold Nanorods and Dark-Field Imaging [†]

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[†] Presented at the 4th International Electronic Conference on Biosensors, 20–22 May 2024; Available online: <https://sciforum.net/event/IECB2024>.

Abstract: The detection of tumor markers in body fluids is crucial for the screening, diagnosis, and prognosis analysis of cancer. Hence, the sensitivity of tumor biomarker screening is highly demanded in detection. Currently, several detection techniques are available, such as a fluorescence analysis, surface-enhanced Raman scattering, electrochemical luminescence, and an electrochemical analysis. However, these methods have certain limitations, such as low sensitivity, poor stability, complex processes, and long reaction time. In recent years, the imaging technique combined with precious metal and dark-field microscopy has gained popularity in the field of highly sensitive biochemical detection due to its high spatiotemporal resolution and independence of signal reporter molecules. Gold nanorods (AuNRs) are anisotropic nanomaterials that show two types of plasmon resonance—longitudinal plasmon resonance and transverse plasmon resonance—in which the longitudinal LSPR plays a dominant role in the detection, while the transverse LSPR mode is always neglected. Herein, polarized light, which is perpendicular to the AuNRs, is designed to stimulate the transverse plasma resonance of the AuNRs to detect biomarkers in a microfluidic chip. In this work, Vascular Endothelial Growth Factor (VEGF₁₆₅) is used as the testing biomarker to demonstrate the feasibility of this method. With the presence of VEGF₁₆₅ in the sample solution, AuNRs will capture the gold nanoparticles due to the antibody–antigen–antibody switched structure, inducing the change in the polarized plasma resonance property. This method achieves a detection limit of 10 pg/mL for VEGF₁₆₅, which is lower than most of the reported methods. The results show that the method based on the combination of a microfluidic chip and dark-field microscopic image has excellent sensitivity and has significant potential in an early cancer diagnosis and prognosis analysis.



Citation: Zhao, C.; Li, S. Ultrasensitive Detection of Biomarkers Based on Anisotropic Gold Nanorods and Dark-Field Imaging. *Proceedings* **2024**, *104*, 2. <https://doi.org/10.3390/proceedings2024104002>

Academic Editor: Michael Thompson

Published: 28 May 2024



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Keywords: biomarker detection; gold nanorodes; dark field imaging; microfluidic chip

Author Contributions: Conceptualization, S.L.; methodology, C.Z. and S.L.; investigation, C.Z.; resources, S.L.; writing—original draft preparation, C.Z.; writing—review and editing, S.L.; supervision, S.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Fundamental Research Funds for the Central Universities, grant number 2023CDJKYJH025.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

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

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