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ABSTRACT

Spectroscopic and Microscopic Techniques in Nano-Probing, Modeling, and Recognition of Cellular Alterations at the Molecular Level

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We have developed and applied an advanced suite of spectroscopic and microscopic techniques for nano-scale probing, modeling, and recognition of molecular-level alterations in cells [1-5]. Our multi-modal approach integrates Fourier Transform Infrared Spectroscopy (FTIR), nano-scale Infrared Spectroscopy (nano-IR), Raman Spectroscopy (RS), Surface- and Tip-Enhanced Raman Spectroscopy (SERS/TERS), Resonance Raman Spectroscopy (RRS), and Atomic Force Microscopy (AFM). These combined methodologies enable the precise characterization of cell membranes, detection of biochemical changes, and exploration of intercellular communication processes [6-7].
The presenantion will highlight the application of these techniques to single-cell analysis, red blood cell (RBC) and endothelial cell (EC) interactions, and the study of cellular alterations in both human and murine models of diseases, including atherosclerosis, diabetes, and heart failure [7-9]. By employing these sophisticated spectroscopic and microscopic tools, we can detect and analyze molecular-level alterations with high precision, offering deeper insights into cell behavior and disease-related changes. This integrated approach has shown significant promise in advancing our understanding of the molecular mechanisms underlying cell function and interaction, as well as in predicting cellular responses in various pathological conditions.

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