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Development of Label-Free Biosensors for Real-Time Molecular Interaction Studies

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The study of molecular interaction kinetics is of crucial importance for fields such as medical diagnostics, pharmaceuticals, and the food industry. Although label-free biosensing methods, such as surface plasmon resonance, are widely used for kinetic studies, they face significant challenges. These include limitations in scaling to observe multiple interactions simultaneously, the complexity and bulkiness of the equipment, as well as the high cost of sensor chips. In this work, we explore and implement an alternative label-free method, spectral correlation interferometry (SCI), which enables parallel monitoring of multiple molecular interactions in parallel and supports multiplexed biosensing. In our system, the multiplexed SCI-based biosensor generates video output signals that record changes in illumination brightness at each point of the biosensor chip. Using advanced signal processing algorithms, including Fourier transformations, filters, and mathematical operations, we transform the brightness variations in the regions of interest on the chip into measurements of the biological layer's thickness. The development and application of these signal-processing algorithms are key steps in creating a fully functional multiplexed biosensor, promising for studying the kinetics of thousands of molecular interactions in real time.

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