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Plasmonic Wave Validation via Finite Element Modeling and Opto-plasmonic System for Biosensor
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Abstract
Plasmonic is light and free electrons interaction in metal nanostructures. Free electrons are oscillated and known as plasmon when light hits the metal. Matched plasmon/ light at respective frequency/ momentum generates a resonance at maximum excitation of plasmonic energy. A resonance shift indicates significant molecular binding for biological matters. Plasmonic biosensors experience unpredictable outcomes without a theoretical agreement. finite element modeling (FEM) could investigate effects, factors and scenarios for a real-time solution. Opto-plasmonic compares FEM to optimize parameters for generating the plasmonic energy. The objective is to perform and validate FEM with an Opto-plasmonic system according to Brewster, critical and resonance angles. A 2D geometries of BK7(1000um)- Au(50nm)- Air(1000nm) were modelled in the Electromagnetic Frequency Domain with Floquet's periodic boundary condition. The Opto-plasmonic consists of 1- Optics (650nm laser, prism, slit, polarizer, photodiode), 2- Mechanical (Bipolar stepper motors, gears, stages) and 3- Electronics (PIC18F4550, LCD and drivers). The P-polarized beam was reflected via a prism and read by a photodiode at 0.045° and 0.1125°, respectively. Experimental to FEM accuracy indicates percentage differences for ϴc, ϴr, ∆r, FWHM, and Rmin at 3.72%, 0.2%, 3.37%, 4.64% and 0%, respectively. Excellence validation was successfully achieved between FEM and Opto-plasmonic. In conclusion, the opto-plasmonic system can generate plasmonic energy for a biosensor application.

Author Keywords
finite element modeling; floquet; FWHM; P-polarized; plasmon; Plasmonic; resonance

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