ELECTROMECHANICAL MODELING OF MICROSCALE BIOSENSORS OPERATING IN VISCOUS MEDIA, C. M. Douglas , S. J. Timpe*, Bradley University, Mechanical Engineering Department, Peoria, IL 61625, sjtimpe@bradley.edu

ABSTRACT

General Physics, Physics, and Materials Science II

The natural frequency of a mechanical system is related to both the mass and stiffness of the device, a fact that can be leveraged to develop highly sensitive microdevices for detecting environmental changes, mass adsorption, *et cetera*. The current research utilizes analytical and numerical modeling techniques to explore multiple designs of microelectromechanical biosensing resonators to detect biological masses adsorbed onto the surface of these microdevices. The final objective of this research is to facilitate drug discovery through *in situ* measurement of changes in mass as unknown biological secondary metabolites bind to resonators pre-functionalized with specific proteins or drug targets. In the application, the microdevices are immersed in liquid solutions containing the biological agents. While this facilitates interaction between the sensor and the biological species, operating in such viscous media complicates the response and the quality of the dynamic response as it is highly dependent on the device geometry and the imposed operating conditions. Analytical and numerical modeling of the oscillatory behavior of different designs operating in typical sensing environments is described. The purpose of this research is to guide optimization of resonator sensitivity and develop accurate relationships between mass adsorption and the resulting shifts in natural frequency. This specific effort examines the implications of dynamic phenomena associated with liquid operating environments on microscale biomass sensing. The results of these simulations will be compared with ongoing experimental work.

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