Thermoviscous Acoustics - Piezoelectric Modeling And Simulation Of Surface Acoustic Wave Devices

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Abstract

New drug discovery and development is costly; of all compounds investigated for use in humans, only a small fraction is approved for treatments around the world. The pharmaceutical industry has started switching from molecular drugs to protein-based drugs due to high specificity, enhanced efficacy, affinity, solubility, and low toxicity. The estimated market growth of protein-based drugs is about 15%, i.e. amounts to total sales of $100 Billion.
Novel Proteins in high concentrations are very expensive to produce. On the other hand, their solution properties, the especially viscosity is very critical to the stability, processing, manufacturing, and delivery of these drugs. Presented research paper describes modeling and simulation of surface acoustic wave devices used for protein characterization with COMSOL Multiphysics.
Typical SAW device converts electrical energy into a mechanical wave on a single crystal substrate. It provides very complex signal processing in a tiny package. Approximately 4 billion SAW devices are manufactured and consumed around the world each year. SAW devices are sensitive to temperature, stress, pressure, liquids, viscosity and surface effects, a wide range of sensors are possible. The devices are small, rugged, stable, and capable of high volume low-cost production. Research focus is on studying modeling and simulation of this devices based on thermoviscous acoustics - piezoelectric interactions Multiphysics interface to characterize conductance, susceptance, viscosity, and other properties of protein samples, like albumin using SAW resonator. This research model is based on the surface acoustic wave (SAW) gas sensor, which analyzes the eigenfrequencies. The model studies how the additional fluid in the groove lowers the resonance frequency.
The successful simulation results of a SAW sensor will detect viscosity of a Protein using thermoviscous acoustic - piezoelectric interactions. Sensors will show a linear relation of admittance data with proteins. The model will accurately predict the behavior of the SAW and fluid interactions. Rigorous analysis of the data will show conductance, susceptance, admittance, resistance, and impedance will establish this research as a comparable study in the SAW sensors field.

Figures used in the abstract

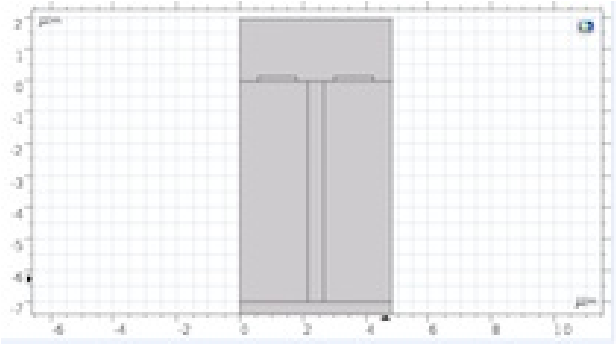

Figure 1 : Surface acoustic wave device with center groove.