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Preliminary exploration of cell-based SAW detection for water toxicity

(Conference Paper)

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Abstract

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Nowadays, many surface sensing mechanisms exist, not all of them can be applied in water-based environment. Most of surface sensing techniques were developed in air-based environment. In order to obtain a potential cell-based biosensor, the sensing method needs to be reliable and repeatable in liquid environment. Therefore, we adapt existing air-based surface acoustic sensor and promote the technology into water-based applications. The goal of this study is to apply surface acoustic waves (SAW) for water-based environment sensing. We will use shear horizontal wave (SH wave) as surface sensing mechanism. SH wave is a type of surface acoustic waves (SAW) which can be used for weight/mass sensing in the air environment. Interdigitated transducers (IDTs) induce the deformation of an ST-cut quartz crystal substrate in AC source and generate waves. With a thin layer of polymer like Parylene and polyimide, the SH wave will be confined between the interface of substrate and polymer layer without suffering the energy loss due to the liquid damping from above. The fundamental frequency of the SAW device is defined by the spacing between the electrodes of IDT. The frequency of interests for this research is below 100 MHz in water-based environment. Due to the stable frequency characteristics of ST-cut quartz in room temperature, this SAW device can be a good candidate for field applications. From an early IDTs design, investigation in material and IDTs configuration is necessary to improve signal quality in order to qualify for liquid phase cell-based bio-sensing applications. A simplified 3D unit cell FEM model is created to study the thickness effects of wave-guide and electrodes. Boundary conditions and assumptions are discussed in the modeling. The simulated eigenfrequency of SH mode is close to the theoretical fundamental frequency of the 64μm wavelength IDTs. The mass damping effects from gold electrodes is more significant than aluminum electrodes. © 2018 ASME.

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Indexed keywords

Engineering controlled terms: Acoustic surface wave devices; Acoustic waves; Airports; Chip scale packages; Damping; Electrodes; Energy dissipation; Liquids; Military bases; Nanosystems; Natural frequencies; Quartz; Shear flow; Shear waves; Ultrasonic transducers

Engineering uncontrolled terms: Aluminum electrodes; Cell-based biosensor; Environment sensing; Fundamental frequencies; Inter-digitated transducers; Shear horizontal waves; Stable frequencies; Surface acoustic wave (SAW)

Related documents

High-sensitivity mems resonant biosensor for monitoring water toxicity
Lee, K.-L. , Ng, S. , Li, F.
(2017) ASME International Mechanical Engineering Congress and Exposition, Proceedings (IMECE)

SAW resonator defects identification technique
Shimko, A. , Stroganov, K. , Kalinin, V.
(2015) 2014 European Frequency and Time Forum, EFTF 2014

Measurement of polymer shear modulus using thickness shear acoustic waves
Holt, R.C. , Gouws, G.J. , Zhen, John.Z.
(2006) Current Applied Physics

Authors > Keywords >

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References (19)

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1 Turner, A.P.F., Karube, I., Wilson, G.S.
(1987) *Biosensors: Fundamentals and Applications*. Cited 1309 times.
Oxford University Press

2 Rapp, B.E., Gruhl, F.J., Länge, K.
Biosensors with label-free detection designed for diagnostic applications
(2010) *Analytical and Bioanalytical Chemistry*, 398 (6), pp. 2403-2412. Cited 64 times.
doi: 10.1007/s00216-010-3906-2
View at Publisher

3 White, D.B.R., Martin, S., Ricco, A., Zellers, E., Frye, G., Wohltjen, H.
(1996) *Acoustic Wave Sensors: Theory, Design, & Physico-Chemical Applications*. Cited 1156 times.
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