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Matched impedance amplifier design for Shear-Force Near-Field Acousto Microscopy

Efficient detection of the acoustic signal constitutes the most critical aspect in Shear-force Acoustic Near-field Microscopy, for reliably characterize the dynamic response of confined fluids under shear stress. Herein we report a 7dB improvement in signal-to-noise sensitivity detecting the acoustic emission from the fluid trapped between a flat sample and the apex of a tapered probe (the latter attached to a quartz tuning fork of 32 kHz resonance frequency). The acoustic signal is monitored as the probe gradually approaches to, and subsequently retracts from, the substrate. The new design capitalizes on the inherent capacitance of the SANM acoustic sensor (comprising a pile of piezoelectric plates) and a proper matching inductor/capacitance combination to altogether optimize its response at 32kHz in a tank-circuit connection fashion. A detailed construction of the circuit amplifier, as well as detailed frequency response bandwidth and noise characterization, is included herein.

Primary author(s) : Mr BROCKMAN, Theodore (Portland State University); SUPICHAYANGGOON, Kacharat; Dr LA ROSA, Andres (Portland State University)

Presenter(s) : Dr LA ROSA, Andres (Portland State University)

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