Contribution ID : **13** Type : **not specified**

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. This characterization technique utilizes the dynamic response of the fluid trapped, under shear stress, between a nanoprobe and a flat substrate. Herein we report a 10dB improvement in signal-to-noise ratio of a piezoelectric acoustic sensor using an impedance matched amplifier circuit. Data was collected utilizing the approach/retraction test method using a SiO2 flat sample and a tapered probe (a silicon pyramid or a conically shaped fiber glass). The Impedance matching capitalizes on the inherent capacitance of the acoustic sensor (a pile of piezoelectric plates) to which we add a matching inductor to optimize the signal at 32kHz (the resonance frequency of the probe) in a tank-circuit fashion. A detailed construction of the circuit amplifier, as well as detailed frequency response bandwidth and noise characterization is included herein.

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Session Classification : Cancelados