Piezoelectric Sensors for Molecular Analysis

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Quartz Crystal Microbalances (QCM) are thin AT-cut quartz discs with circular gold electrodes on both sides. The application of an electrical field results in the mechanical deformation of the crystal driving it to oscillate at a specific frequency. These devices attained significance as analytical tools after the discovery that there is a linear relationship between immobilized mass and the crystals' oscillation frequency. The Sauerbrey equation predicts the mass sensitivities on the nanogram/cm^2 range.

QCMs operating in liquid phase also sensitively respond to the viscosity, density, and ionic strength of the solutions. Impedance spectroscopy methods must be used to distinguish mass load from liquid damping due to the solutions properties, as well as to characterize the deposited films.

This communications addresses the steps involved in the development of piezoelectric sensors for molecular analysis in solution. Alkanethiols self assembled monolayers were used and the immobilization kinetics on the crystals gold surface was measured. The effect of buffer ionic strength, density and viscosity was investigated to optimize QCM performance in terms of binding monitoring. The optimized methodology was further used to develop gene sensors. Synthetic oligonucleotides were thus immobilized at the electrode surface and complementary DNA sequences were detected in real time.