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# Piezoelectric biosensor for the estimation of environments in a closed-ecosystem

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In recent years, piezoelectric quartz systems have been used in analytical chemistry because their oscillating frequencies are sensitive and have wide range. A quartz crystal microbalance (QCM), which is a nanogram mass sensing device, has been applied to determine gases, ions, and some biomolecule. These studies are based on the fact that the resonant frequency change of the quartz crystal corresponds to mass change on the crystal surface.

In this study, we used the QCM as a transducer for the measurement of cell growth. As a result of the current experiment, both the dry cell weight and the living cell weight were linearly proportional to the frequency change in the range of $10^{-8}$ to $10^{-5}$ gram when our QCM sensor was used for the measurement. Namely, the measurement of bacterial cell weight is possible within this range using the sensor. Furthermore, we have succeeded in living cell adhesion to the gold surface of the quartz crystal in our own QCM system. Although cells adhered to the surface under growth media containing serum, a stable unchanging oscillation frequency occurred. In the device, living cells serve as the sensing element, where cellular mass and viscoelasticity affect the frequency of the crystal.

We aim to construct the simple piezoelectric biosensor for the estimation of ecological environments (e.g., water, soil, or air pollution containing cytotoxic activity). Because the cell adhesion change can be monitored as frequency change of the quartz in the system, this biosensor will be also useful for the real time identification or screening of biologically active drugs or biological molecules that affect cell adhesion. This method will also be variable to analyze the behavior of cells in the closed-ecosystem.

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