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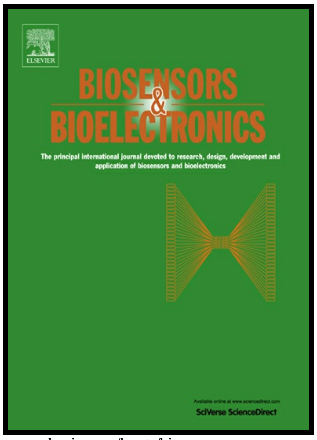

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Use of Torsional Resonators to Monitor Electroactive Biofilms

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Highlights

- Torsional acoustic resonators allow to determine the thickness of biofilms.
- The growth of an electroactive biofilm was monitored.
- The viscoelastic stiffness of the film increases during growth.
- The biofilm softened, when the layer's metabolism was slowed down.

Abstract:

Whereas the study of interfaces and thin films with the quartz crystal microbalance (QCM) is well established, biofilms have proven to be a difficult subject for the QCM. The main problem is that the shear wave emanating from the resonator surface does not usually reach to the top of the sample. This problem can be solved with torsional resonators. These have a resonance frequency in the range of tens of kHz, which is much below the frequency of the thickness-shear QCMs. The depth of penetration of the shear wave is correspondingly larger. Data acquisition and data analysis can proceed in analogy to the conventional thickness-shear QCM. Torsional resonators may also be operated as electrochemical QCMs (EQCMs), meaning that a DC electrical potential may be applied to the active electrode and that shifts of frequency and bandwidth may be acquired in parallel to the electrical current. Here we report on the formation of mixed-culture biofilms dominated by the microorganism *Geobacter anodireducens*. The viscoelastic analysis evidences an increase in rigidity as the films grows. Potential sweeps on electroactive biofilms reveal a softening under negative potentials, that is, under conditions, where the layer's metabolism was slowed down by insufficient oxidative activity of the substrate. For comparison, biofilms were monitored in parallel with a conventional thickness-shear QCM.

Keywords: Quartz Crystal Microbalance, Whole-Cell-Based Biosensing, Biofilms, Geobacter Acoustic Sensors, Biofuel Cell

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