NEW INSIGHTS IN ADSORPTION PROCESSES OF LUBRICANT ADDITIVES

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ABSTRACT

Since the initial studies by *Spikes* in the 80s, adsorption mechanisms of lubricant oil additives gained significant attention, as can be seen by a total of approximately 20 publications in 2018 (see e.g. [1,2]). The presented theories are mostly based on ex- and post-mortem studies or simulations. Here, we present in-situ adsorption studies, using a quartz crystal microbalance with dissipation QCM-D (e.g. [3,4]).

The QCM-D is a nanogram-sensitive technique to study adsorbed amounts (from frequency information) and viscoelastic properties (from dissipation) of the adsorbed molecules. Fig. 1 shows an exemplary frequency and dissipation shift during adsorption of a friction modifier from mineral base oil. The frequency decreases after the media change from base oil to base oil + additive, which indicates a mass increase (adsorption). The dissipation increases after the medium change, so the additive coating shows an increased viscoelasticity compared to the pure base oil. Interestingly, by changing the medium back to pure base oil the frequency decreases and the dissipation slightly increases again. To understand this phenomenon an additional method is needed. The QCM-D gives no information exceeding quantitative adsorption and viscoelasticity. To describe the coating more precisely and also in a qualitative way we used an imaging method to make the adsorption processes, as seen via QCM, visible. The combination of both methods gives interesting new insights in the behavior of lubricant oil additives on surfaces.

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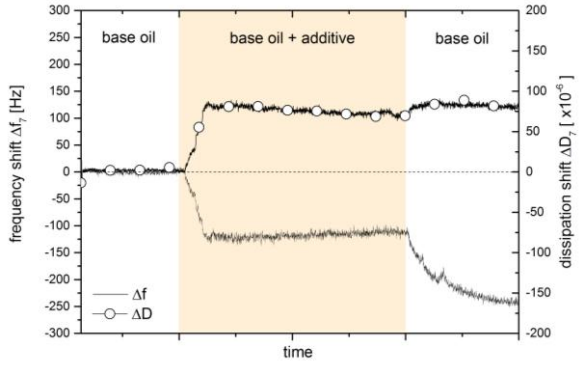

Fig.1 Exemplary frequency and dissipation shift from QCM-D tests: adsorption of friction modifier from mineral base oil

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