Monitor the Adsorption of Bromine Vapor on Zeolitic-Imidazolate Framework-8 Film by an Electrodeless Quartz Crystal Microbalance in Overtone

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In this work, the overtone response of an electrodeless quartz crystal microbalance (EL-QCM) in gaseous phase was investigated by an impedance analysis method. It was shown that the influence of the electrode gap on the resonant frequency reduces with increasing overtone number. Although reduced with increasing overtone, the effective quality factor is still high enough even at 7th overtone (3.8 ± 10^4) for the stable resonance of the EL-QCM. The EL-QCM was applied to monitor the adsorption processes related to corrosive gas, modeling by bromine vapor onto zeolitic-imidazolate framework-8 (ZIF-8) film. It was shown that the 2-methylimidazole unit in ZIF-8 plays important role for Br₂ adsorption, preponderating in chemical adsorption. The adsorption kinetic data are in agreement with the pseudo-second-order model. The adsorption isotherms are well fitted by the Langmuir model with the saturation adsorption capacity of 3241 mg/g on ZIF-8 with thickness of 0.699 μm (25°C). The correlations of the frequency shifts at the overtone (n=1,3,5) can be employed to judge the rigidity of the film in an adsorption process.

Keywords: Quartz crystal microbalance; Electrodeless; Overtone response; Bromine adsorption; Zeolitic-imidazolate framework

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