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Detection of Volatile-Organic-Compounds (VOCs) in Solution Using Cantilever-Based Gas Sensors

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Abstract

Micromechanical resonant sensor offers many advantages for chemical detection, but it fails to maintain high quality factor (*Q*-factor) when working directly in liquid because of the viscous damping. To solve the problem, a gas/liquid separated sensing method is introduced to detect volatile organic compounds (VOCs) in solution with a resonant cantilever gas sensor. With the help of a waterproof and breathable expanded polytetrafluoroethylene (ePTFE) film, the resonant sensor can be physically isolated from the analyte solution. Thus, the sensor can resonate in gas phase environment with a high *Q*-factor, meanwhile the interference from the solvent emission can be significantly suppressed. Loaded with the sensing-group functionalized mesoporous-silica nanoparticles (MSNs), the resonant cantilever can detect the target VOC molecules that permeate from the flowing solution sample at the other side of the film. Two typical kind of resonant microcantilever VOC sensors are tested to verify the proposed method, which are loaded with carboxyl (–COOH) and amino ($–NH_2$) sensing groups functionalized MSNs, respectively. The sensors exhibit highly sensitive (*mg/L* level resolution) and reproducible