Micromechanical Chemical and Biological Sensors

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Although the physics of adsorption-induced surface stress has known for almost a century, no attempt has been made to exploit this concept for a chemical and biological sensing. We have demonstrated a novel micromechanical sensor based on adsorption-induced forces on microcantilevers with a parts-per-trillion sensitivity. In contrast to approaches that are based on resonance frequency variation due to mass adsorption, sensors based on chemical adsorption-induced surface stress is 1000 times more sensitive. These microcantilevers have a typical dimension of 100-200 µm length, 20-30 µm width, and 0.3-0.6 µm thickness. Since the cantilevers are very thin they undergo bending due to adsorption induced forces (surface stress variation) that can be measured with a sub-nanometer resolution. These sensors can work in air, vacuum, or under liquid. This sensor has direct application to virtually any type of chemical sensing. Since the thermal mass of the cantilever is extremely small, they can be temperature scanned and cooled in few seconds enabling chemical identification, reaction rate control, and regeneration. These extremely sensitive microcantilever sensors can be micromachined and mass produced for low cost. An array of hundreds of cantilevers each coated with chemically specific coating and control electronics can fit into less than a square centimeter making an ideal multi-chemical detector

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