Explosive/Water Vapor Adsorption on Microcantilevers Coated with a Self-Assembled Monolayer of Mercaptobenzoic Acid

L. A. Pinnaduwage, J. E. Hawk, V. Boiadjiev, and T. Thundat
Oak Ridge National Laboratory, P. O. Box 2008, Oak Ridge, TN 37831-6123

We have measured the adsorption of characteristics of explosive vapors and water vapor on a silicon microcantilever, where one of its surfaces was coated with a self-assembled monolayer (SAM) of mercaptobenzoic acid. Mass loading of the cantilever was measured by monitoring the shift in cantilever resonance frequency. In addition, the bending of the cantilever due to the surface stress was also monitored. Even though hydrogen bonding is expected to be responsible for the attachment of both molecular species to the SAM coating, the adsorption characteristics were quite different for water and explosive molecules. In the case of water vapor, the mass loading and bending both increased with relative humidity in a linear fashion. With increasing humidity, more and more water layers were deposited on the cantilever, and up to 80 monolayers were estimated to be deposited at a relative humidity of 60%. For explosive vapors such as pentaerythritol tetranitrate (PETN), mass loading and bending increased rapidly with PETN concentration to a maximum of one monolayer coverage. We will discuss the surface mechanisms involved in drastically different response for adsorption of water and explosive molecules.

Oak Ridge National Laboratory is managed by UT-Battelle, LLC, for the U. S. Dept. of Energy under contract DE-AC05-00OR22725.