Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Contact Mechanics Studies with the Quartz Crystal Microbalance

F. NELSON NUNALEE, KENNETH R. SHULL, Northwestern University — The mechanism of adhesion between two surfaces that are immersed in a liquid medium is a problem of critical scientific and industrial importance. Practical applications range from targeted drug delivery systems to coatings that are designed to resist fouling by marine organisms. However, quantitative measurement of adhesion in liquids is often complicated by difficulties in determining the true nature of the contact between the two surfaces. In some cases a lack of optical contrast makes it difficult to visualize the contact area, whereas in other cases the optically determined contact may not represent a region of true mechanical contact. We have utilized the quartz crystal microbalance (QCM) in contact mechanics experiments because its response is coupled to the surface rheological properties of the materials that are pressed against it. We have shown that when a hemispherical polymer gel is brought into contact with the electrode surface of the QCM, changes in both the resonant frequency and the dissipation are proportional to the gel/QCM contact area. The actual proportionality constants are determined by the high frequency rheological response of the gel. As a result we have been able to calibrate the QCM for use as a highly sensitive contact sensor for fundamental studies of adhesion of polymer gels.

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Date submitted: 23 Nov 2004 Electronic form version 1.4