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Viscoelastic Characterization of Gels at Metal-Protein Interfaces[1]

ELIZABETH MARTIN, KENNETH SHULL, Dept. of Materials Science and Engineering, Northwestern University — The interfacial gelation of proteins at metallic surfaces was investigated with an electrochemical quartz crystal microbalance (QCM). When Cr electrodes were corroded in proteinaceous solutions, it was found that gels will form at the Cr surfaces if molybdate ions are also present in the solution. A similar film will form on Cr when the proteins are replaced with a poly(allylamine) polyelectrolyte, suggesting that the gelation is due to a cross-linking reaction between the protein amine groups and the molybdate ions. Further, a method was developed to characterize the viscoelastic properties of thin polymeric films in liquid media using the QCM as a high frequency rheometer. By measuring the frequency and dissipation at multiple harmonics of the resonant frequency, the viscoelastic phase angle, density —modulus product, and mass per unit area of a film can be determined. The method was applied to characterize the protein films, demonstrating that they have a phase angle near 80° and a density —modulus product of $\sim 10^7$ Pa-g/cm^3. Data imply that the gels are comprised of a weak proteinaceous network and exhibit similar mechanical properties as solutions containing 50 wt% protein.

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