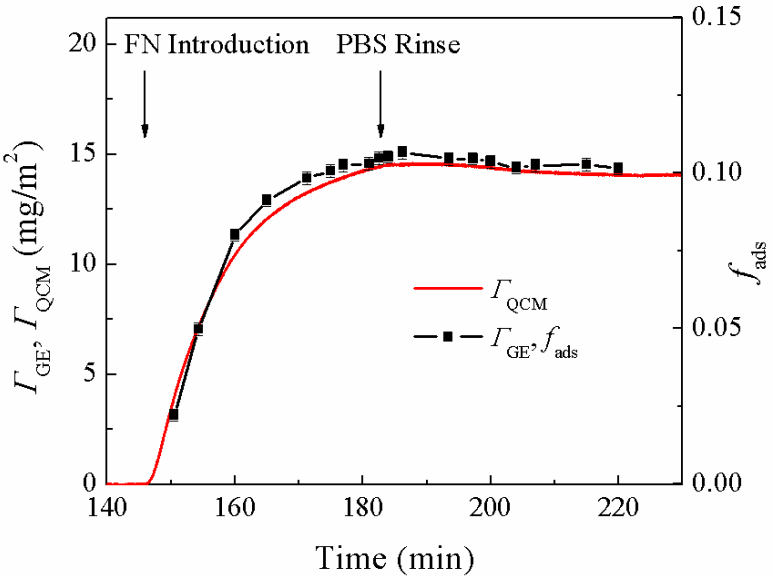
Generalized ellipsometry in-situ monitoring of fibronectin protein infiltration of sculptured thin films

K.B. Rodenhausen, D. Schmidt, T. Kasputis, A.K. Pannier, E. Schubert, and M. Schubert

University of Nebraska-Lincoln
Lincoln, NE 68588-0511
USA



Sensor technologies are being developed to detect the presence of analytes including specific DNA sequences [1] and contraband [2]. Sculptured thin films (STFs) produced by electron-beam glancing angle deposition (GLAD) are promising scaffolding materials for such sensors. STFs offer increased surface area and are thus expected to increase the per area efficiency of sensors. Many applications necessitate real-time in-situ measurements under native liquid ambient. Generalized ellipsometry (GE) is sensitive to the anisotropic properties of STFs. Therefore, GE analysis should further improve the detection limits for analytes that infiltrate a STF.

We introduced a fibronectin protein phosphate buffer saline (PBS) solution over a Ti-TiO2 STF and monitored adsorption and rinsing processes with simultaneous, in-situ GE and quartz crystal microbalance with dissipation (QCM-D) techniques. An anisotropic Bruggeman effective medium approximation was applied to our optical model to determine the volume fraction of fibronectin present within the STF.

We find that anisotropic Mueller matrix elements are sensitive to fibronectin adsorption and that the protein infiltrates the STF and does not simply form an additional isotropic layer on top. Additionally, the GE and QCM-D dynamic measurements show good agreement on the amount and rate of fibronectin adsorption, which we relate via geometry calculations.

[1] W. Yang, J. Y. Gerasimov, and R. Y. Lai, Chem. Commun., 2902 (2009).

[2] R. M. Burks, S. E. Pacquette, M. A. Guericke, M. V. Wilson, D. J. Symonsbergen, K. A. Lucas, and A. E. Holmes, J. Forensic Sci., 55, 723 (2010).