

The Transmission Interference Adsorption Sensor (TInAS)

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INTRODUCTION: The time-resolved measurement of molecular adsorption onto surfaces yields a wealth of valuable information about surface properties, solution properties, and adsorbent properties, adsorption mechanism as well as specific or unspecific adsorbent-surface interactions. Here we describe a novel high-speed adsorption sensor based on thin-film interference at interfaces. This Transmission Interference Adsorption Sensor (TInAS) can be used as stand-alone instrument or in combination with a direct surface force measurement, which yields a wide range of additional information on molecular interactions on adsorbed films.

METHODS: The TInAS uses white light that is directed through a transparent dielectric multilayer structure, with each layer exhibiting a different refractive index. Partial reflections at these optical interfaces lead to the formation and superposition of multiple beams—giving rise to an interference effect in the reflection- and transmission- spectra. Analysis of such interference fringes can be used to determine small changes of film thickness, as for example, due to molecular adsorption at the sensor surface. The experimental challenges of the described method are an accurate wavelength calibration and an accurate wavelength determination of feeble interference maxima.

The measurement spot size is one micrometer or more and sampling rates >10Hz are readily possible. In contrast to other bio-sensors, the signal baseline has a remarkable long-term stability since the measured signal is virtually independent of refractive index changes in the fluid medium above the sensor surface.

RESULTS: We demonstrate sensor operation for various bio-sensor configurations, including specific protein adsorption onto a functionalized polymer surface from aqueous solution and water adsorption from the gas phase.

In combination with an optical spectral correlation method [1], the classical computer calculations are substituted by an optical calculator and a label-free real-time imaging adsorption sensor is realized. This imaging capability of the new sensor technology is illustrated on a patterned bio-functionalized surface.

DISCUSSION & CONCLUSIONS: The achieved mass resolution of the presented method ($1-10 \text{ ng/cm}^2 \sqrt{\text{Hz}}$) is comparable or better than other modern bio-sensors. The dependence of mass resolution on various factors is presented and demonstrated in a number of relevant examples. The described method is suitable for the implementation of a low-cost bio-sensor with a minimal number of optical elements.

REFERENCES: ¹ T.E. Balmer, M. Heuberger (2007) submitted to *Rev. Sci. Instr.*