Resonance Amplified Optical Detection of Biological Macromolecules Using a New Signal Transduction Approach Based on Visible-light Diffraction Dratings

R.C. Bailey and J.T. Hupp*
Dept. of Chemistry and Institute for Nanofabrication and Molecular Self-Assembly
Northwestern University
2145 Sheridan Road
Evanston, IL 60208 USA

Soft lithography techniques have been used to prepare micropatterned structures composed of chemo- and bio-responsive materials. The structural periodicity creates a refractive-index periodicity that causes the patterns to behave as diffraction gratings for visible light. Binding, adsorption, or absorption of a chemical or biological target molecule causes a change in refractive index contrast and an easily measured change in diffraction efficiency. First generation sensors based on chemoresponsive diffraction gratings and real-component modulation of refractive indices have proven competitive with (but considerably simpler and less expensive than) quartz crystal microbalance based sensors.

Second generation sensors make use of imaginary components of the refractive index for highly analyte specific resonance amplification of sensor signals. Consequently, selectivity is enegendered at both the analyte-recognition stage and the signal-readout phase. By using multiple probe colors (e.g. low-cost light sources such as laser pointers) or by using appropriately designed resonant tags (e.g. metal or semiconductor nanoparticles) multiplexing is possible. Depending on the target, we find that detection limits for resonance amplified diffraction can exceed by a few orders of magnitude those achievable either by surface plasmon resonance or surface acoustic wave techniques. Additionally, resonance *de*amplification can be used to defeat signals from selected interferents. Representative new results for highly specific, amplified detection of DNA and low molecular weight proteins will be presented.

REFERENCES:

"Real-Time Multicolor DNA Detection with Chemoresponsive Diffraction Gratings and Nanoparticle Probes", R. C. Bailey, J.-M. Nam, C. A. Mirkin, and J. T. Hupp, J. Am. Chem. Soc., **125,** 13541 (2003).

"Large-Scale Resonance Amplification of Optical Sensing of Volatile Compounds with Chemoresponsive Visible-Region Diffraction Gratings," R. C. Bailey and J. T. Hupp, J. Am. Chem. Soc., **124**, 6767 (2002).