

PHOTONIC LATTICES AS DIFFRACTION BASED CHEMICAL SENSORS

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A new approach to chemical sensing based upon the modulation of coherent visible light by chemo-responsive photonic lattices will be presented. Sensors are designed so that they produce an optical diffraction pattern that reports on the local environment of the lattice. The ratio of light diffracted into one first-order diffraction spot ($I_{1,0}$) to the undiffracted spot ($I_{0,0}$) is operationally defined as the “diffraction efficiency”.

Changes in the “diffraction efficiency” of a lattice induced by interaction with a volatile or condensed-phase analyte provides the sensing modality. Initial results showed appreciable absolute sensitivity when used under “off resonance” (non-light absorbing) conditions. When implemented under resonance conditions, significant amplification and *de*-amplification effects are observed, resulting in a more responsive and potentially more selective sensing regime.

The methodology presented is potentially universal since all atomic and molecular analytes possess polarizable electrons, and thus have refractive indices greater than vacuum. Most are greater than water, allowing for aqueous sensing.

The relative simplicity of the experimental design makes the technique attractive for mobile, low-cost sensing applications. While not developed here, the technique clearly can be implemented in an array motif, and clearly can be extended to biological sensing, including whole cell sensing.(1) Furthermore, as we have shown elsewhere, variants of the technique can be usefully applied to other problems, including monitoring molecular adsorption at electrode/solution interfaces,(2) and determining conduction-band-edge energies for nanocrystalline semiconductor electrodes.(3)

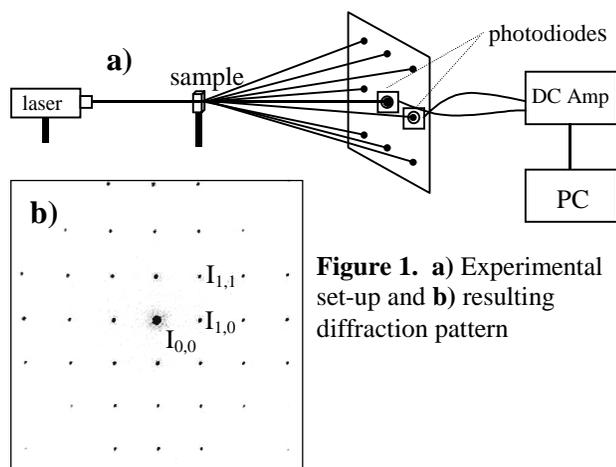


Figure 1. a) Experimental set-up and b) resulting diffraction pattern

1. R. C. Bailey, M. Parsek, and J. T. Hupp, unpublished results.
2. X. Dang, K. J. Stevenson, and J. T. Hupp, *Langmuir*, accepted (2000).
3. X. Dang, A. M. Massari, and J. T. Hupp, *Electrochem. and Solid State Lett.*, **3**, 555 (2000).