Lithographically Defined Nanostructures for Biological Sensing Applications

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The use of various photopatterning techniques to create micro/nano structured electrodes is described: Porous carbon electrodes are fabricated by interferometric lithography (IL) to generate 3-D periodic structures in pyrolyzed photoresist that contain five patterned layers with microporous hexagonal lattices (~ 800 nm in diameter). [1] Because IL is a maskless approach porous carbon structures are able to be produced with defect-free 3-D lattices and sub-wavelength periodicity uniformly over samples in excess of 2 cm a side. Despite a high degree of interconnectivity, the relatively large pore sizes preserve hemispherical diffusion inside the structures which exhibit diffusion profiles similar to microelectrodes. [2] We demonstrate that these porous carbon structures can be used as a highly adaptable electrode material for the deposition of metal nanoparticles and conducting polymers with possible applications in biological and chemical sensors. Direct writing patterning techniques, such as stereolithography and two photon polymerization are then used to create hollow bore microneedles that can be integrated with carbon fiber or carbon paste electrodes for transdermal sensing applications. The detection of ascorbic acid, hydrogen peroxide, glucose, lactate, and pH with these devices will be presented with an emphasis on characterizing microenvironments due to metabolic acidosis.

[1] a) D. B. Burckel, C. M. Washburn, A. K. Raub, S. R. J. Brueck, D. R. Wheeler, S. M. Brozik, and R. Polsky *Small* **2009** *5,* 2792-2796.

[2] X. Xiao, M.E. Roberts, D.R. Wheeler, C.M. Washburn, T.L. Edwards, S.M. Brozik, G.A. Montaño, B.C. Bunker, D.B. Burckel, R. Polsky, *ACS Appl. Mat. and Inter*., **2010** 2, 3179-3184