Micropatterned CVD Diamond Microelectrode Arrays for Electrochemical Analysis

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Abstract
The unique electrochemical properties of diamond such as a wide working potential window, low background current and prolonged stability make it attractive for applications in electrochemical analysis and synthesis. High quality and conductive diamond films have found to exhibit active voltammetric response without the need for surface pretreatment.[1-2] In principle, the superior detection figures of merit for diamond, particularly the limit of detection and sensitivity, can be further improved by shrinking the electrode geometry with microfabrication techniques. Increased sensitivities and decreased limits of detection can be achieved due to enhanced mass transport to the interfacial reaction zone. The background signals should be lower due to the decreased overall electrode area, relative to the geometric area. Both of these factors would lead to enhanced signal/background ratio, increased sensitivity and decreased limits of detection. Experimental research are needed to determine the factors that influence the structure-reactivity relationship in CVD diamond microelectrode

This paper reports on the design, fabrication and characterization of boron-doped CVD diamond microstructural electrode arrays for electrochemical analysis/sensing and to provide new insights on diamond electrodes design and fabrication. Various geometrical structures of diamond microelectrode arrays such as microtips, microdisces, and microbands have been designed and fabricated by plasma enhanced chemical vapor deposition of diamond incorporated with *in situ* gas phase doping method. The fabrication utilizes a micro patterning technique to produce a well-defined diamond microstructural array with good uniformity control. SEM and optical pictures of various electrode patterns are shown in figures 1 to 4. The fabrication process of the electrodes and the electrochemical behaviors as a function of electrode geometry, size and array configuration will be reported.

References
[1] T. A. Railkar, W. P. Kang, Henry Windischmann, A. P. Malshe, H. A. Naseem, J. L. Davidson, and W. D. Brown, "A Critical Review of Chemical Vapor-Deposited (CVD) Diamond for Electronic Applications," *Critical Reviews in Solid State and Materials Sciences*, 25(3), pp. 163-277, (2000).
[2] G. M. Swain, J. C. Angus and A. B. Anderson, "Applications of Diamond Thin Films in Electrochemistry," *MRS Bulletin*, 9, 56 (1998).

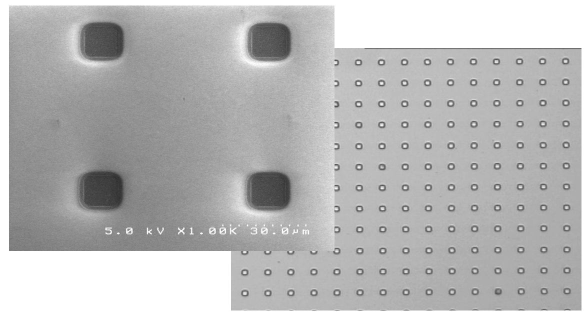

Fig. 1: An array of a 10 um squares with 50um spacing between squares

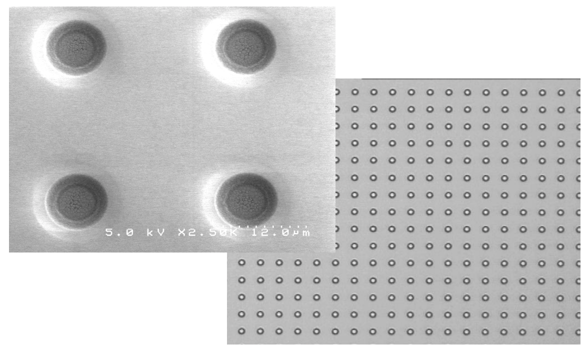

Fig.2: An array of 4 um circles with 20 um spacing between circles

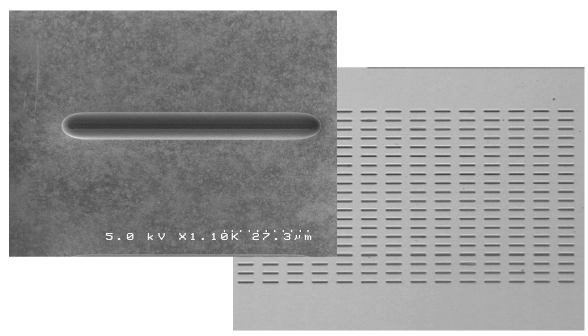

Fig. 3: An array 2 x 80 um rectangles

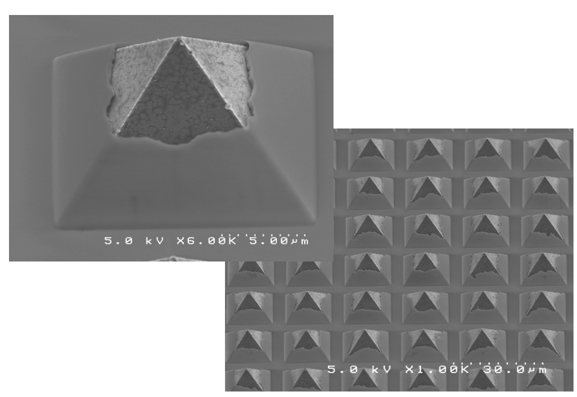

Fig 4: SEM of an array of diamond tips covered with a layer of SiO_2