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Wafer Level Fabrication of Nanowell Array Biochip and Its Characterization

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Abstract

Recently biochips of nanoscale dimension have attracted wide attention for sensitive, multi-targeting and labeling-free biomolecule detection. Especially the use of nano-well array (NWA) biochip is so efficient for sensitive and quantitative analysis because it efficiently minimizes the unwanted, non-specific binding or aggregation of biomaterials. There are conventional methods for fabrication of NWA structure such as e-beam lithography (EBL), nanoimprint lithography (NIL), nanosphere lithography (NSL) and so on. These methods are capable of creating nanopatterns, but limited to a small area and low throughput. In order to solve these problems, we developed a highly reliable and high-throughput wafer level fabrication process for NWA biochips and investigated its characteristics based on electrochemical analysis. A KrF stepper was used to define nanoscale patterns in a 6 inch SiO_2 wafer. Uniform and clearly defined 57 chips were achieved in a wafer. Each nanowell showed a diameter of 500 nm with an interspacing of 200 nm and a height of 200 nm. The current path of SiO_2 based NWA was obtained by current sensing AFM (I-AFM). The applicability of this NWA biochip was demonstrated by using streptavidin-biotin and the stress-induced-phosphoprotein-1 (STIP-1), a biomarker for an ovarian cancer as an antigen. The electrochemical measurements of CV and EIS evaluation were performed on NWA chips.