# Novel 3D Integration Technology for Whole Cell Bio-Electrochemical Sensor

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3D integration allows for the vertical stacking of electronic, electrochemical, and other micro-system technologies. In this work we present a novel three-dimensional electrochemical sensor fabricated from a PDMS substrate with through-substrate via contacts. The electrodes and vias are based on conductive PDMS thus forming a flexible, "all polymer" biochip. The flexible chip consist an electrochemical cell with two gold electrodes (working and counter) and an Ag/AgCl electrode as a quasi-reference. The metal electrodes are fabricated by conventional electroplating and patterning methods. In conventional 2D designs, the electrodes and contacts are on the upper face of the biochip. In the new 3D design, electrodes are located on one side of the substrate and contacts on the opposite side allowing the output of electrical signals to the potentiostat and the signal processing units. Vias are fabricated in the PDMS substrate by cast molding and are filled with conductive PDMS (70 wt% Ag powder) with resistance measured through the 2 mm diameter,1.5 mm long vias is lower than 1 Ω. Electrochemical characterization of the chip was carried out by measuring the redox behavior of p-aminophenyl phosphate in a cyclic voltammetry analysis. The 3-D sensor exhibited stable voltammetric signatures in repeated tests. These results show that the described system is suitable for future *in-vitro* & *in-vivo* upward measurements.