# A Microfluidic Platform for Electrochemical Concentration and Detection

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## Abstract

A poly(methyl methacrylate) (PMMA) microfluidic platform with a hot-embossed microchannel, 150 mm wide and 20 mm deep, was developed for multiple purpose detection using electrochemical methods. This device is able to accommodate a three-electrode system encased in 1/16" diameter PEEK tubing; and these electrodes are removable so they can be cleaned, polished and calibrated before and after experimental runs. Interchangeable micro-disc working electrodes can be used depending on the desired analyte detection; and a "leak-less" reference electrode was employed. Electrochemical characterization is performed using cyclic voltammetry and chronoamperometry at flow rates between 0.1 and 5 mL/min and analyte concentrations between 5 and 20 mM. The effect of scan rates between 20-100 mV/s during cyclic voltammetry was also studied. The application of convection greatly affects the current density at the electrode surface and the shape of the cyclic voltammograms. A 3D numerical simulation was developed for cyclic voltammetry and chronoamperometry in the device at different flows, concentrations, and scan rates, using COMSOL Multiphysics® software with the experimental and simulation results showing good agreement over the range of conditions studied and helped us identify several minor flaws in our platform design.

## Figures used in the abstract

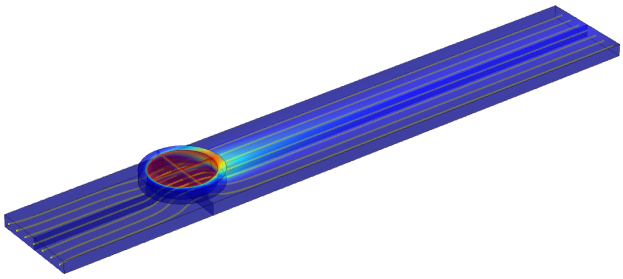

**Figure 1**: COMSOL GEOM showing electrode recessed 20 microns into PEEK housing above the microchannel. Including this recess in the simulation dramatically improved agreement between theory and experiment. This figure shows streamlines (yellow tubes) and the concentration of the oxidized species.