High Performance Macroporous Silicon Chemical Sensor With Improved Phase Detection Electronics

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ABSTRACT:

In this paper, a high sensitive, stable and reproducible electrical chemical sensor system based on macroporous silicon has been developed. Screen printed metal contacts have been taken from macroporous silicon layer which result in extremely stable, quasi ohmic and reproducible contacts. Such a sensor structure has been characterized for different organic and ionic solutions commonly used for biochemical applications. The sensitivity of the reported sensor at a particular frequency has been found to be almost ten times compared to previous reports of macroporous silicon sensor where contacts are taken from the backside and also in comparison to interdigited electrode array structure. The improvement and variation of sensitivity with frequency for different solutions has been explained taking into account the dependence of double layer impedance with frequency, distributed RC networks of the macroporous silicon structure, ionic conductivity of the solution and effects of ion sizes. However, from the impedance measurement it has been observed that the sensor capacitance with such stable contacts has an ultra low-Q value and to exploit such sensor for portable field use systems, an embedded signal conditioning unit has been realized to display the measured capacitance value after offset compensation and reduction of parasitic effects.