Electrical Conductance Measurements of Fluidics

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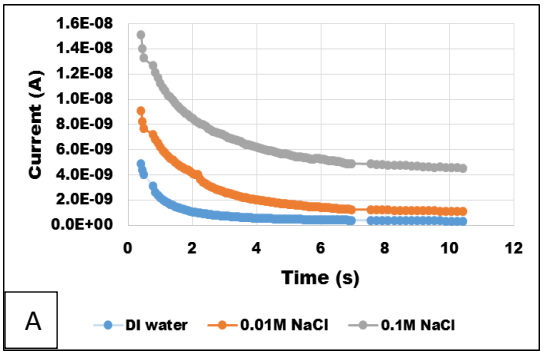
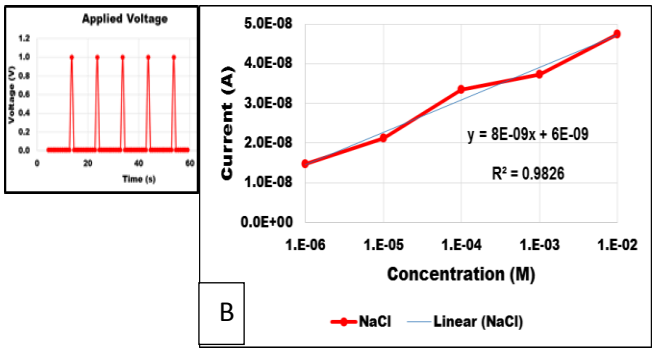
Abstract

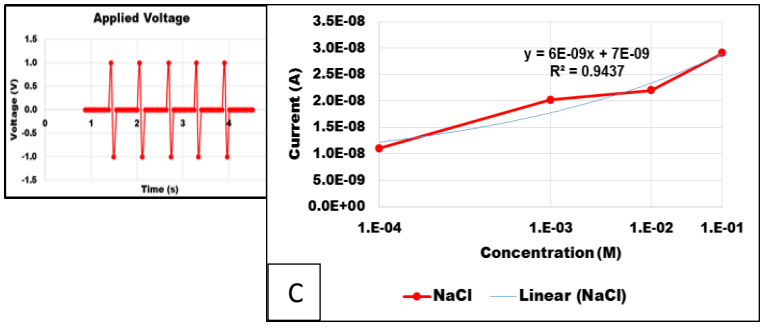
In this work, DC conductance measurement techniques are analyzed which overcomes the limitations of several AC models, especially with respect to polarization, the parallel (C_p) and series (C_s) cell capacitances. Thesemeasurement analysis are done electrochemically on a silicon oxide micro gap structure with gold electrodes. Time domain potentiostatic methods namely voltage bias measurement, single pulse measurement and bipolar pulse method are carried out to accurately measure the response. The conductance of aqueous NaCl at concentration ranging from 0.1mM to 100mM was investigatedusing these methods. Conductance values as high as 11ns for 0.1mM, 20ns for 1mM, 23ns for 10mM and 29ns for 100mM concentrated aqueous solutions were measured. The Bipolar pulse method is more robust approach which is fast, accurate, wide ranged and independent of C_p and C_s as it overcomes some of the limitations of other DC techniques. In this method, consecutive equal magnitude but opposite polarity pulses of constant voltage are applied as input to the cell and the current/voltage ratio is measured at the end of the second pulse. The unwanted double layer impedance is reduced to a vanishingly small value due to small electrode polarization caused by the accumulation of ions on the surface of electrodes.



Exponential decay of gap current with time when DC voltage of 1V is applied



Single potential pulse of 1V is applied and corresponding current variation as a function of concentration is measured



Bipolar potential pulse of 1V and -1V is applied and corresponding current variation as a function of concentration is measured

Fig. Three separate conductance measurement techniques (A,B,C) are analyzed on microgap and the variation of current with different concentration of NaCl solution is experimentally depicted as a function of time.