Utilization of Dielectrophresis to position Nanowires for potential bio-sensor applications

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When the molecules of interest interact with the surface of the nanowires there is a resultant change in the conductivity of the nanowire allowing specific molecules to be detected selectively. As such nanowire based microfluidic devices have been demonstrated as flow rate sensors [1] and for the detection of specific chemical and biological molecules. While much of this work has focused on use of silicon nanowires or carbon nanotubes, indium arsenide based wires are also of interest due to their high carrier motilities and the presence of a surface charge accumulation layer making them more sensitive to their ionic environment. To date such devices have been realized by removing the NWs from their host substrate and using expensive and time consuming pick and place techniques (i.e. utilizing SEM and AFM techniques) to deposit the NWs onto the microfluidic structures.

In this work we have utilized dielectrophresis, allowing us to control and position individual nanowires electronically. During a dielectrophertic process (DEP), a polarizable nano-object is subjected to a non-uniform alternating electric field, the intrinsic charges separate and accumulate at the surface to form a dipole, [2] which then experiences a force dependent on the gradient of the electric field. This results in the self-assembly of the dipoles across the electrode gap. As a first step, we have investigated the relationship between the DEP process parameters and the quality of the captured NWs, allowing us to select only the high quality NWs. Figure 1 shows the relationship between the quality of the NWs as a function of the DEP frequency used and the resultant device IV characteristics. We intend to further this work by only using the best performing devices to realize ionic sensors.

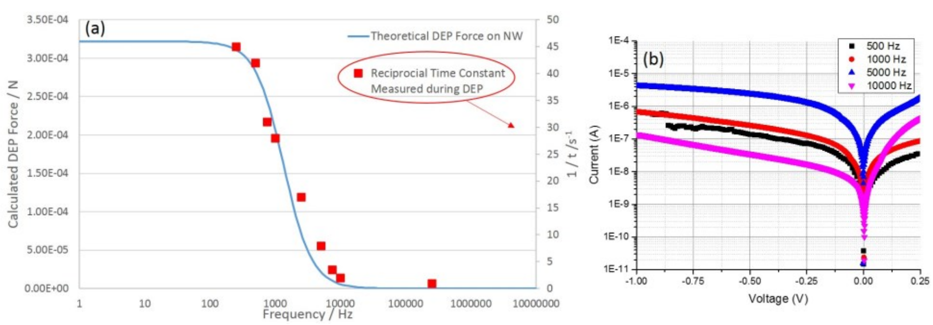

Figure 1: (a) The calculated DEP force on InAs NWs as a function of frequency and the measured reciprocal time constant of the particle capture, (b) the measured IV characteristics for the resultant diodes.

Références :

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