Signal Enhancement in High Ionic Strength Achieved with Transistor-based Biosensors

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Field-effect transistors (FETs) detect the intrinsic charges of the target biomolecules allowing for a label-free and highly sensitive real-time detection. This charge-based sensing however is impeded in the presence of high ionic strength solutions due to Debye screening, limiting applications of FET bio-sensors in complex physiological samples. Recently, polyethylene glycol (PEG) has been reported to increase the Debye length (λ_D) if immobilized together with receptor molecules on the sensor surface.[1] Using DNA as a model system, we quantify the extent of λ_D increase and show that local desalting stemming from the salting-out effect of PEG in aqueous salt solutions could explain the reduced Debye screening effect under high ionic strength environments. Using extended-gate FET (EGFET) and quartz crystal microbalance with dissipation (QCMD) measurements, we show that within the mixed layer of PEG and DNA, the effective ionic strength is reduced by at least 10× compared to surfaces without PEG. This in turn increases the Debye length within the PEG-DNA layer, allowing the detection of DNA charges further away from the sensor surface.

REFERENCES:

1. N. Gao, W. Zhou, X. Jiang, G. Hong, T-M. Fu, and C. Lieber. *Nano Lett.* **15**, 2143 (2015).