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Graphene decorated with mu-opioid receptor: the ionic screening effect and detection of enkephalin JINGLEI PING, A.T. CHARLIE JOHNSON, Department of Physics and Astronomy, University of Pennsylvania, RENYU LIU, Department of Anesthesiology and Critical Care, University of Pennsylvania, A. T. CHARLIE JOHNSON TEAM, RENYU LIU COLLABORATION — We investigated the properties of graphene field effect transistors (GFETs) decorated with a computaionally redesigned, water-soluble variant of the human mu-opioid receptor (wsMOR) in physiological buffer solution. The shift of the Fermi level in the GFETs is quantitatively described by chemical-gating effect of charges on the wsMOR that are screened by the ionic solution. Our results suggest that sensitivity to the molecular target is lost when the Debye screening length of the solution is shorter than the distance from the graphene to the wsMOR; thus de-salting may be necessary when wsMOR decorated GFETs are used as biosensors in solution. We used this insight to detect DAMGO, a synthetic analog to the endogenous opioid peptide encephalin, at a concentration of 10 pM (5.1 pg/mL) in artificial cerebrospinal fluid (aCSF) diluted to 5% of its normal salt concentration. When the sensors were measured in a dry state, the limit of detection for DAGMO was 1 pM (0.5 pg/mL), one-third of the baseline in human body.Funding for this work was provided by DARPA.

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