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Radiofrequency Nanoelectrolytic Debye-Layer Transistor JEAN-LUC FRAIKIN, UC Santa Barbara, MICHAEL REQUA, MICHAEL STANTON, ANDREW CLELAND, UC Santa Barbara — A voltage-biased metal immersed in an aqueous electrolyte attracts ions from the solution, causing the accumulation of a diffuse layer of charge close to its surface. This layer is called the Debye-Huckel layer, or double layer. For a non-reactive electrode, the electric double-layer (EDL) presents a capacitive electrical impedance, which depends non-linearly on the voltage applied across it. We present a novel transistor whose transduction element is the EDL capacitance, which allows electronic gating of a 50 MHz signal at frequencies close to 1 MHz. The transistor comprises three terminals: a pair of nanofabricated interdigitated electrodes (IDEs) embedded in an electrolyte-filled microfluidic channel, and a third, gating Ag/AgCl electrode in the same fluid volume. We demonstrate direct gating of the transistor with the Debye layer, and make use of the device to measure the voltage dependence of the EDL capacitance over a broad range of electrode bias.

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