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Field Regulation of Single Molecule Conductivity by a Charged Atom

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A new concept for a single molecule transistor is demonstrated [1]. A single chargeable atom adjacent to a molecule shifts molecular energy levels into alignment with electrode levels, thereby gating current through the molecule. Seemingly paradoxically, the silicon substrate to which the molecule is covalently attached provides 2, not 1, effective contacts to the molecule. This is achieved because the single charged silicon atom is at a substantially different potential than the remainder of the substrate. Charge localization at one dangling bond is ensured by covalently capping all other surface atoms. Dopant level control and local Fermi level control can change the charge state of that atom. The same configuration is shown to be an effective transducer to an electrical signal of a single molecule detection event. Because the charged atom induced shifting results in conductivity changes of substantial magnitude, these effects are easily observed at room temperature. [1] Paul G. Piva1,Gino A. DiLabio, Jason L. Pitters, Janik Zikovsky, Moh'd Rezeq, Stanislav Dogel, Werner A. Hofer & Robert A. Wolkow, Field regulation of single-molecule conductivity by a charged surface atom, NATURE **435**, 658-661 (2005)