

Room-temperature gating of molecular junctions using few-layer graphene nanogap electrodes

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Motivation:

<http://xxx.lanl.gov/abs/1110.2335>

- Gateable molecular junctions (Au, Pt – no gated transport)
- (sp²-)carbon-based materials, covalent bond-structure
 - stability @ RT
 - large variety (thiol and amine linkage, π - π stacking interaction)
- Thin electrodes, reduced screening of the applied gate-field
- Conductance is largely gate-independent (not like SLG, CNT)
 - features from the contacted molecule

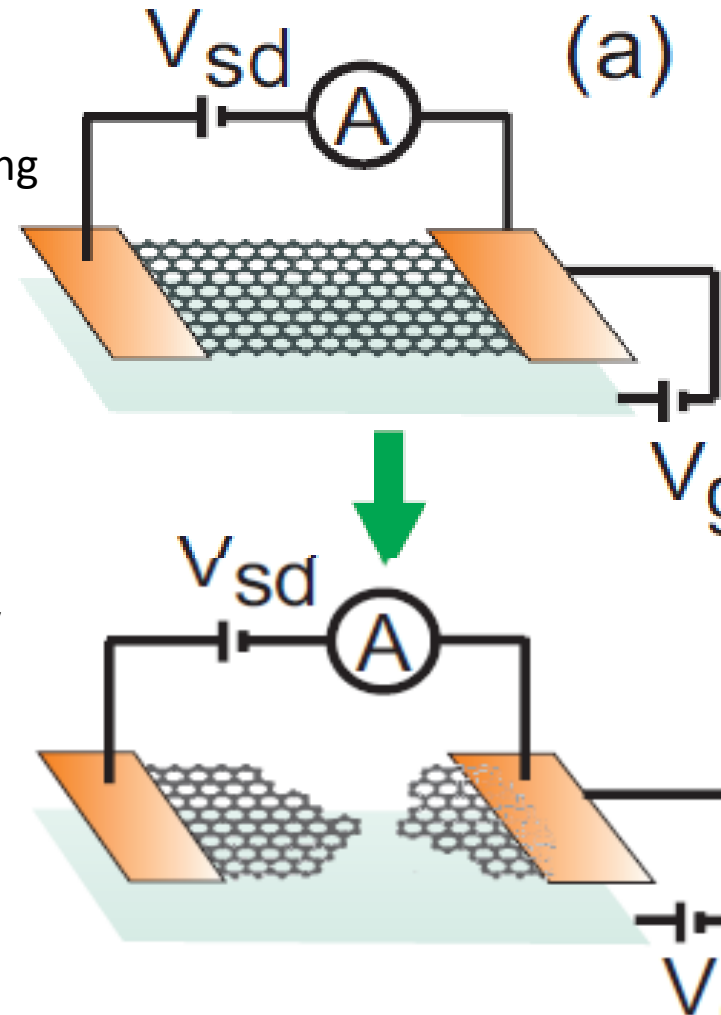
Few-layer graphene (FLG) electrodes:

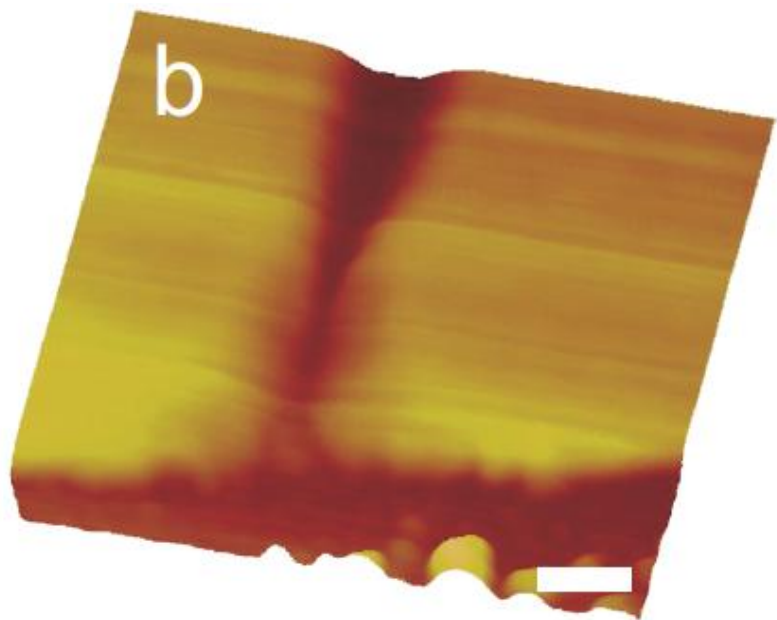
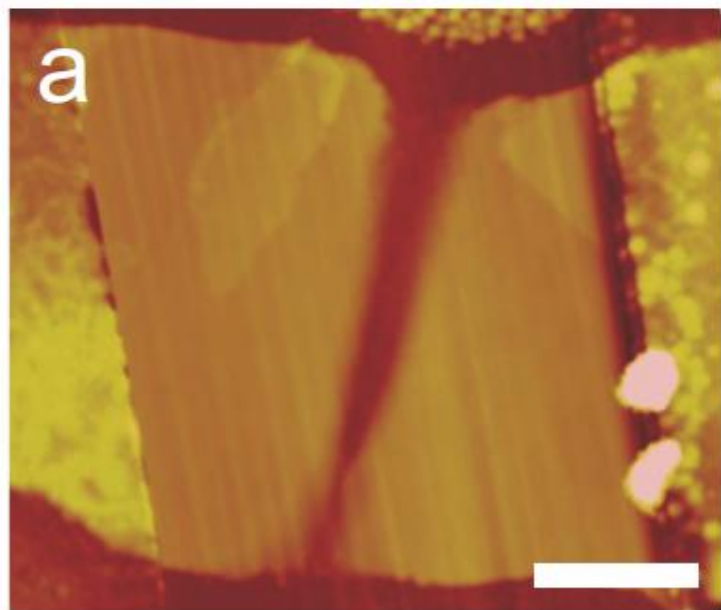
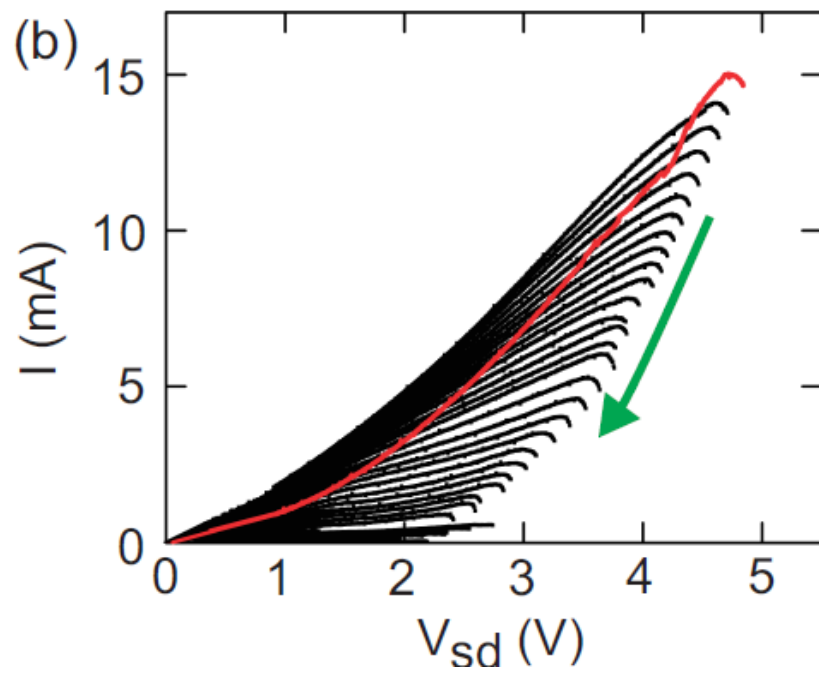
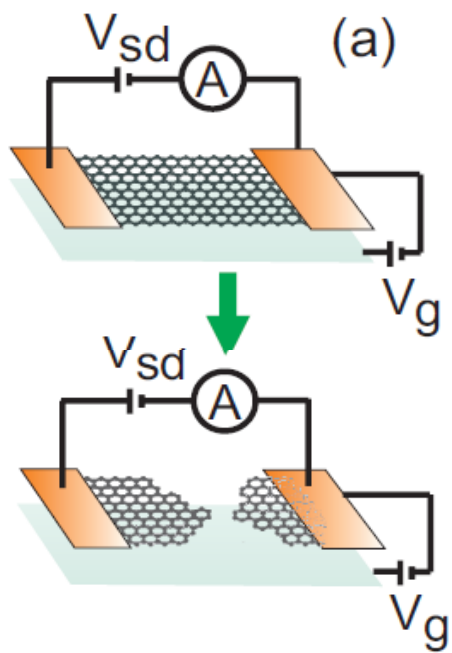
- Stoch tape - EBL - oxygen-plasma etching, Cr/Au → gap-size >10nm
- AFM nanolithography
- Nanoparticles catalyzed anisotropic etch
- ...
- Feedback-controlled electroburning

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Sample fabrication using feedback-controlled electroburning (FDE):

- Starts from 3-18nm thin graphene flakes deposited using stoch tape technique
 - Cr/Au electrodes
 - FDE@RT:
 - Related to the chemical reaction of C and O
1. Voltage (V) ramp applied (1V/s), while current (I) monitored w/ high frequency (200ums)
 2. $\Delta G/G / 200\text{mV} >? 10\% \rightarrow V$ swept back to 0V in 10ms
 3. goto 1.





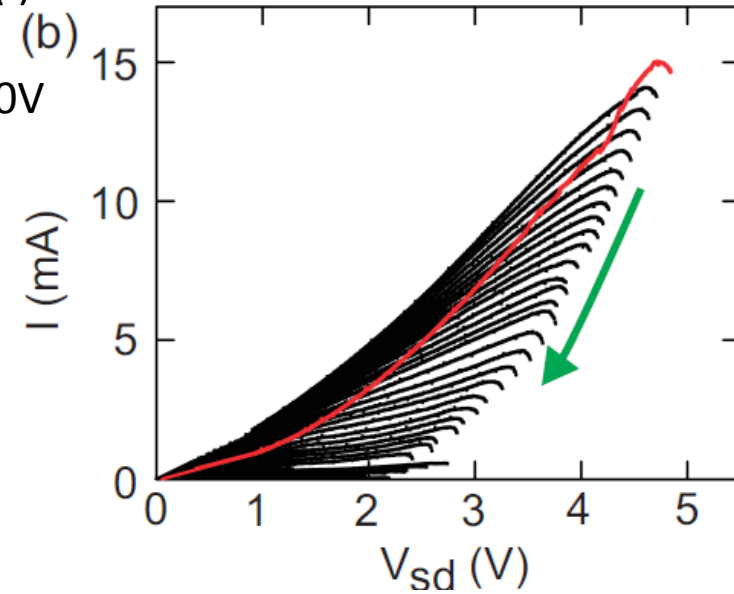
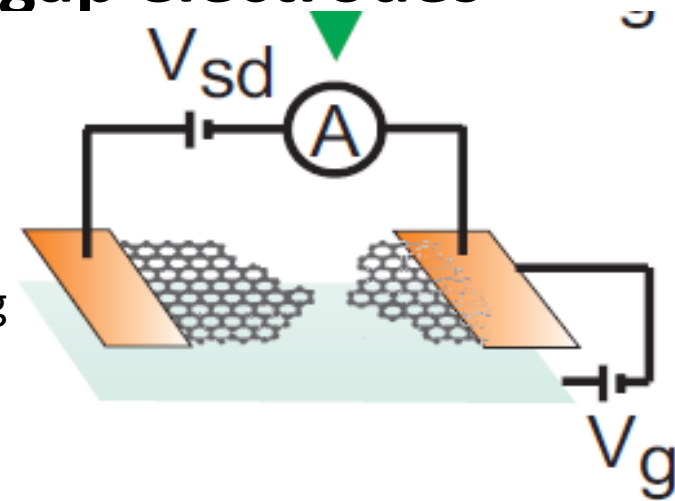
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- Critical current density $5.3 \times 10^7 \text{ A/cm}^2$
- Gap $\sim 1\text{-}2\text{nm}$, height 12nm(35layer) remains
- $200\Omega\text{-}3\text{k}\Omega \rightarrow 500\text{M}\Omega\text{-}10\text{G}\Omega$



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AFM characterization is difficult

→ I-V curves, single barrier

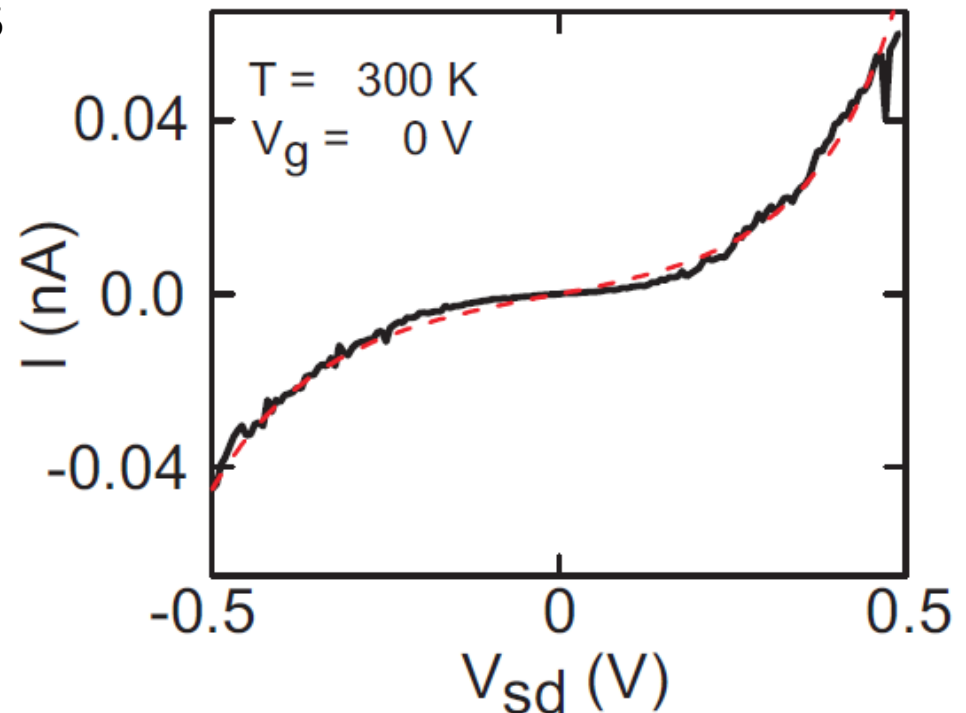
SIMMONS model:

- Barrier height → 1-2nm
- Gap size → 0.92eV
- Bias-Voltage response → -0.35

→ Stable for weeks

→ absence of gate-dependence

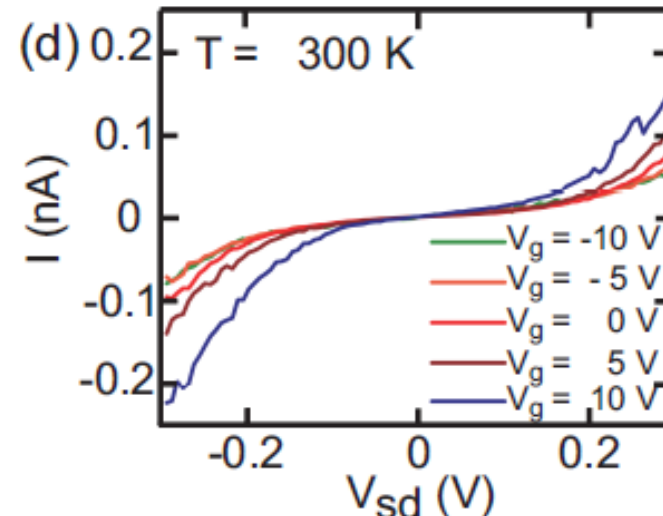
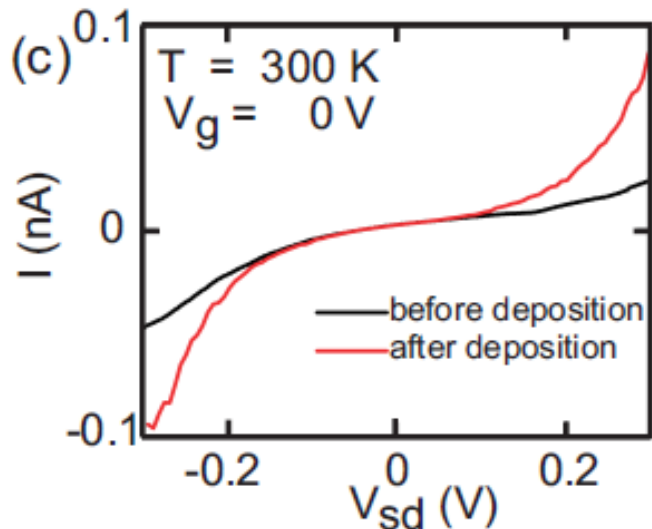
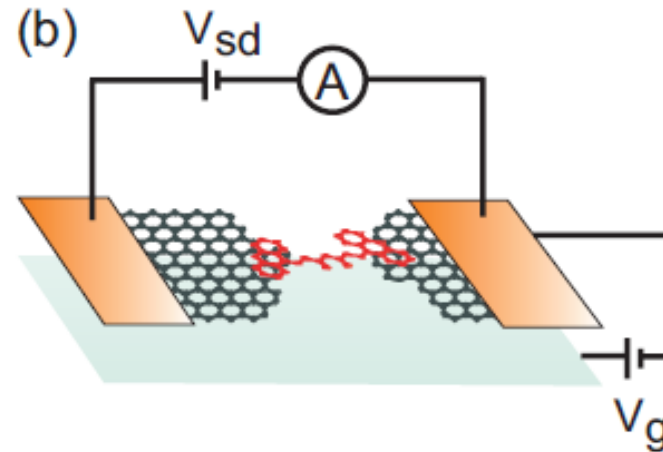
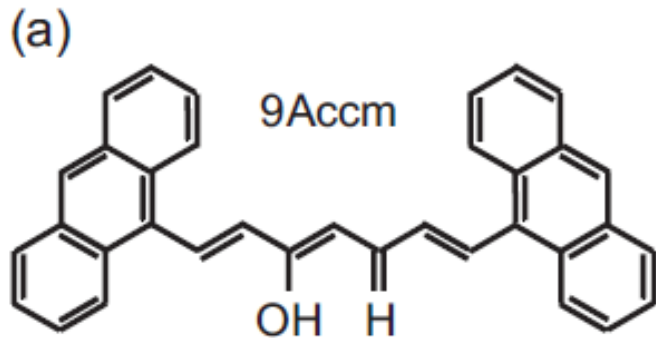
→ can be used for the characterization of small molecules



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Anthracene-functionalized curcuminoid molecules deposited:

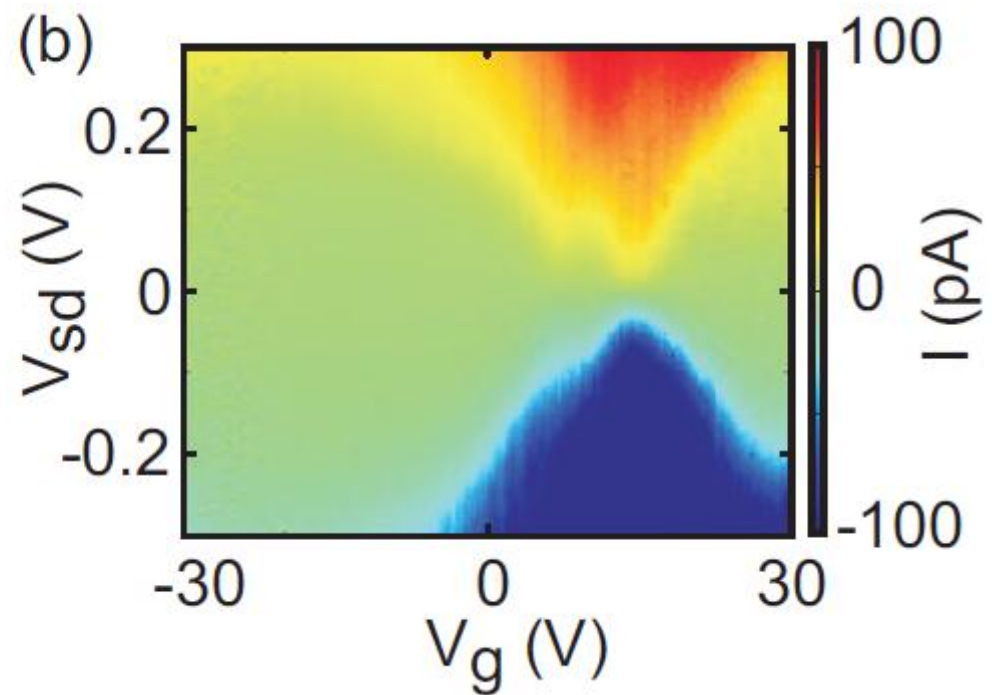
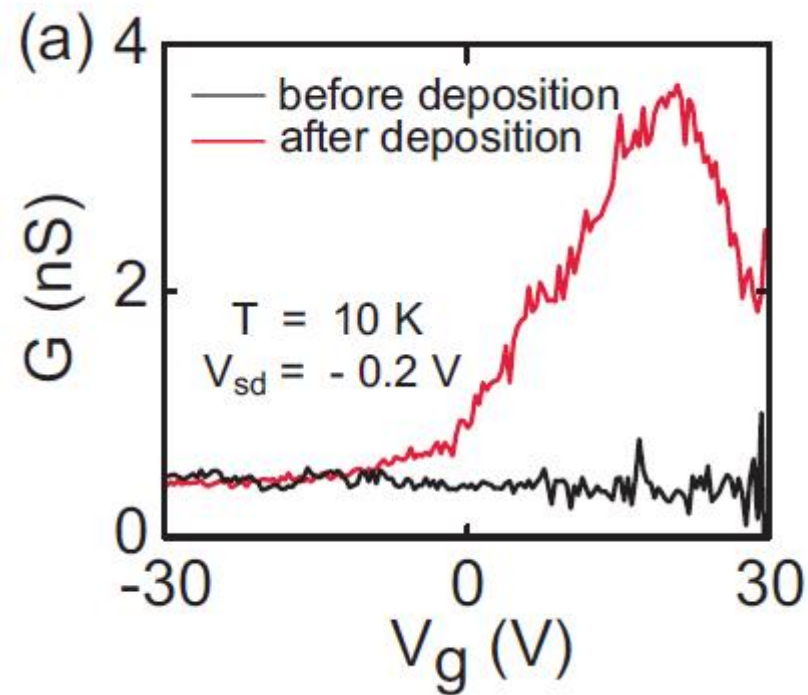
1,7-(di-9-anthracene)-1,7 heptadiene-3,5-diene



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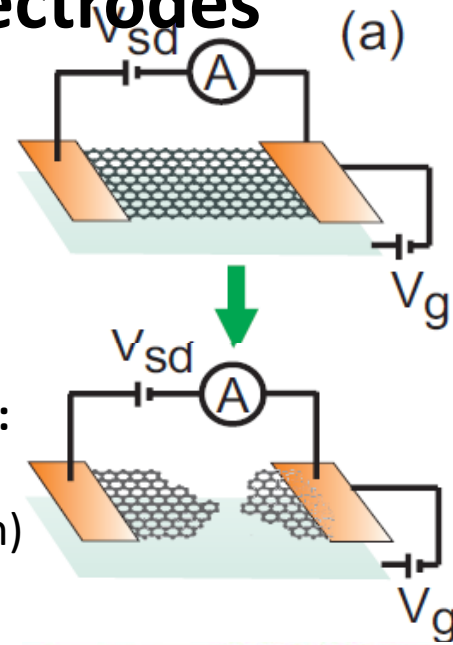
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