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. $\Delta G/G / 200mV > 10\% \rightarrow V$ swept back to 0V in 10ms
3. goto 1.
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- Critical current density $5.3\times10^7$ A/cm$^2$
- Gap $\sim$1-2nm, height 12nm (35layer) remains
- $200\Omega$-$3k\Omega \rightarrow 500\Omega$-$10G\Omega$
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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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