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

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Motivation: http://xxx.lanl.gov/abs/1110.2335

- •Gatebable 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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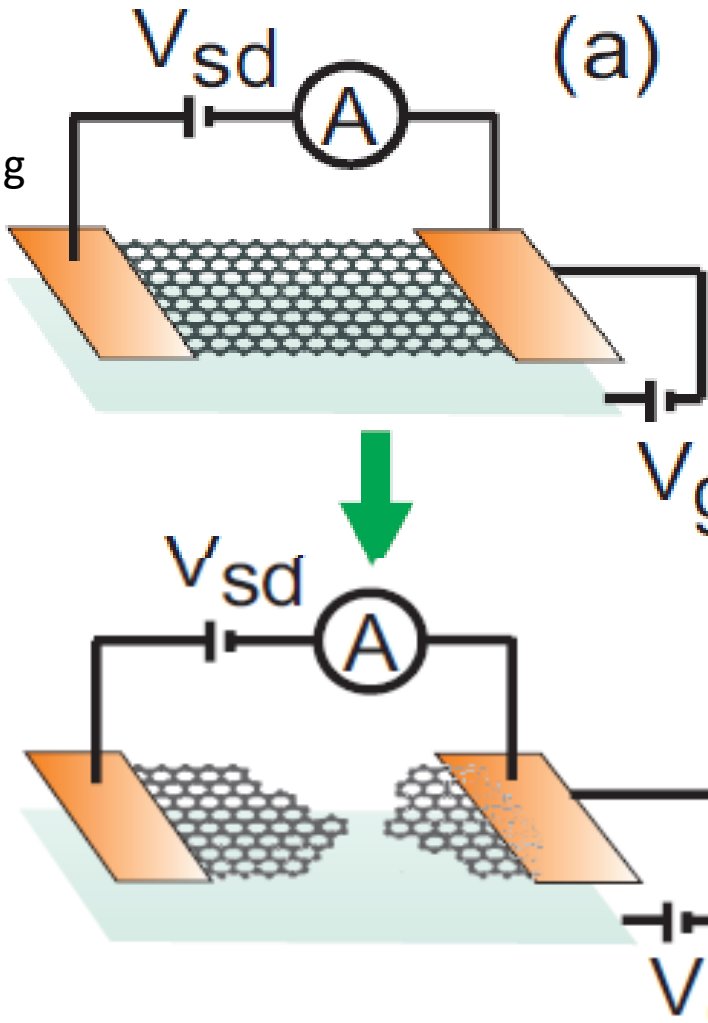
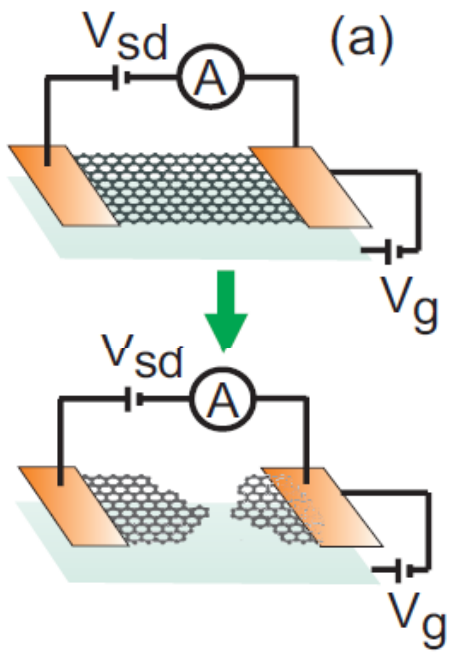
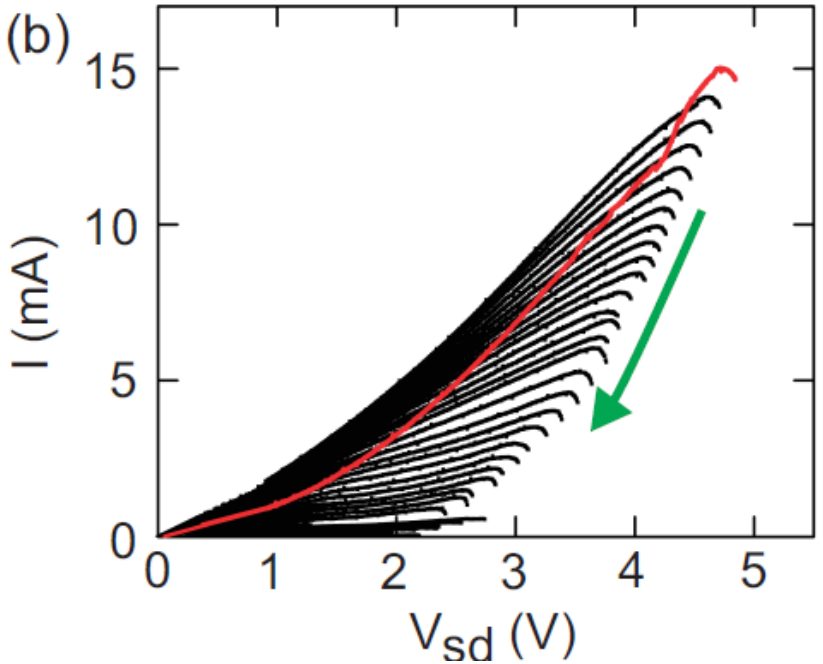
Sample fabrication using feedback-controlled electroburning (FDE):

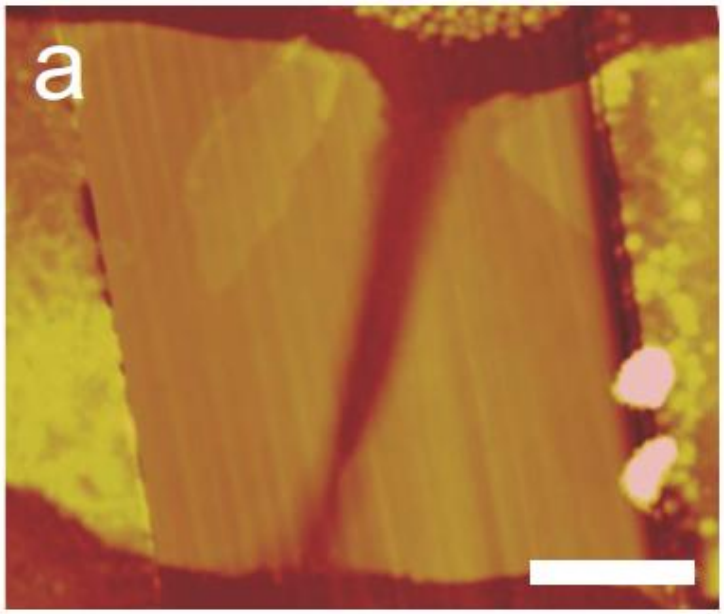
- Starts from 3-18nm thin graphene flakes deposited using stoch tape technique
- Cr/Au electrodes
- FDE@RT:
  - Related to the chemical reaction of C and O

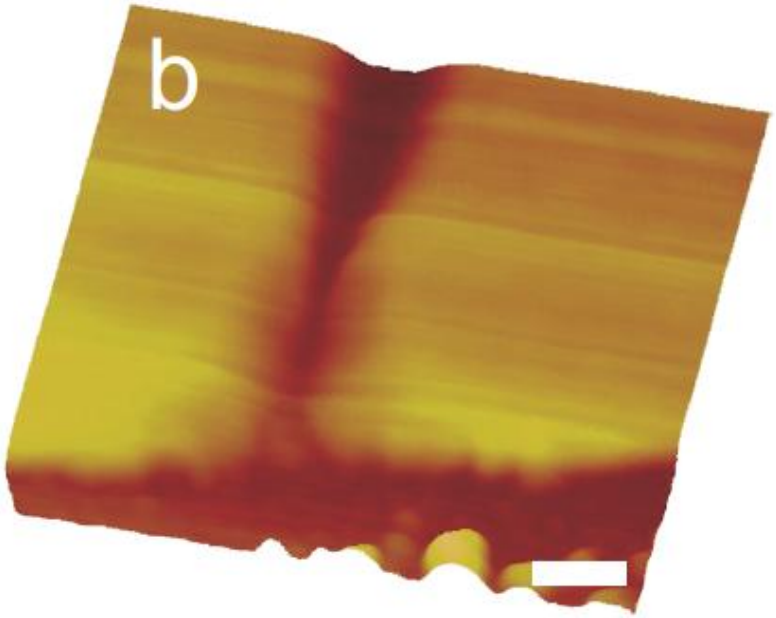
1. Voltage (V) ramp applied (1V/s), while current (I) monitored w/ high frequency (200ums)
2. $\Delta G/G$ / 200mV >? 10% → V sweeped back to 0V in 10ms
3. goto 1.




V_{sd}
A
(a)
V_g
V_{sd}
A
V_g


(b)
15
10
5
0
I (mA)
0
1
2
3
4
5
V_{sd} (V)


a


b

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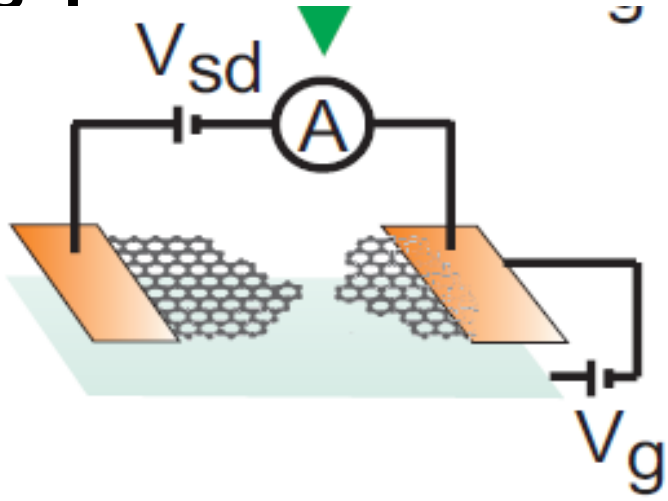

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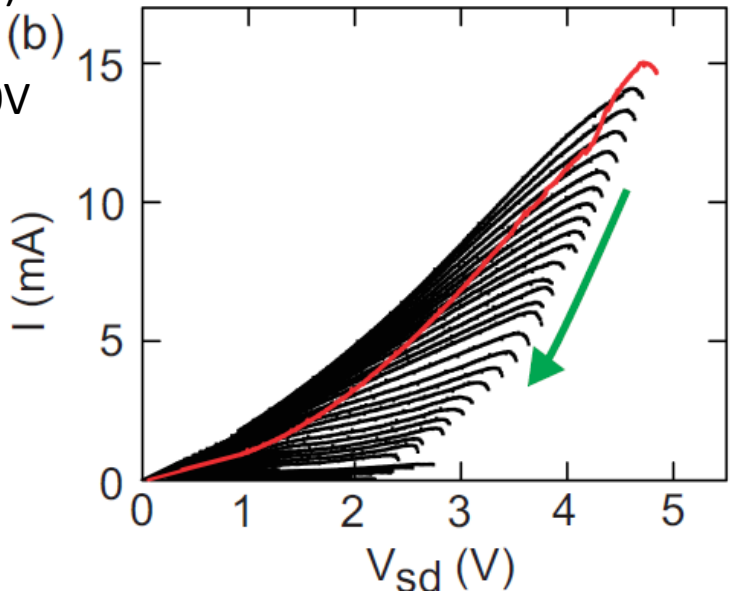

- Critical current density 5.3×10^7 A/cm^2
- Gap ~1-2nm, height 12nm(35layer) remains
- 200Ω-3k Ω →500MΩ -10GΩ

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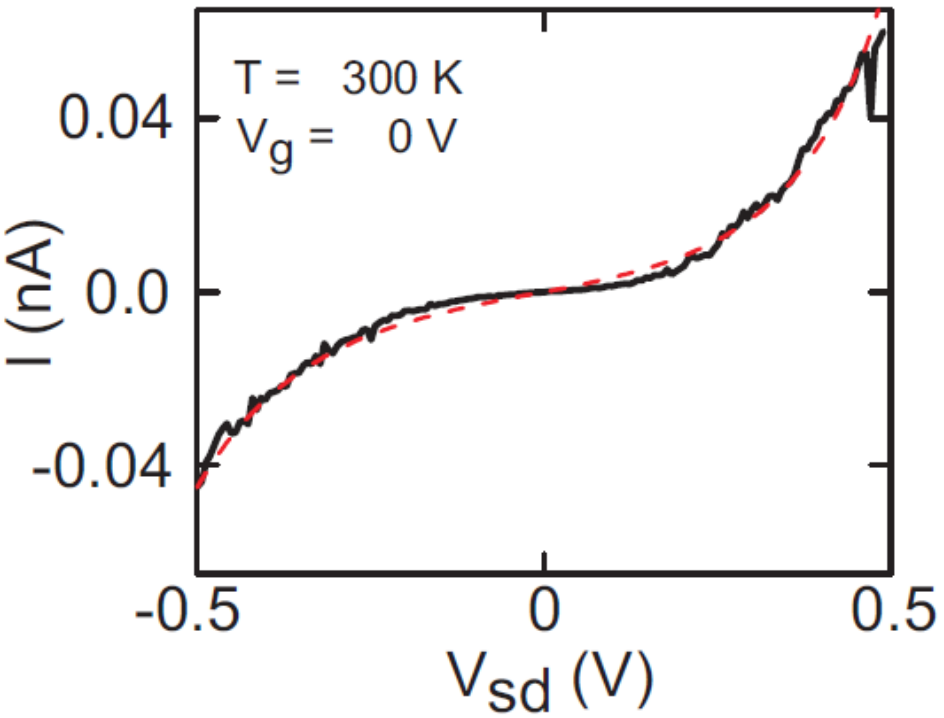
AFM characterization is difficult
→I-V curves, single barrier
SIMMONS model:
•Barrier height → 1-2nm
•Gap size →0.92eV
•Bias-Voltage response →-0.35

→ Stable for weeks
→abscence of gate-dependence

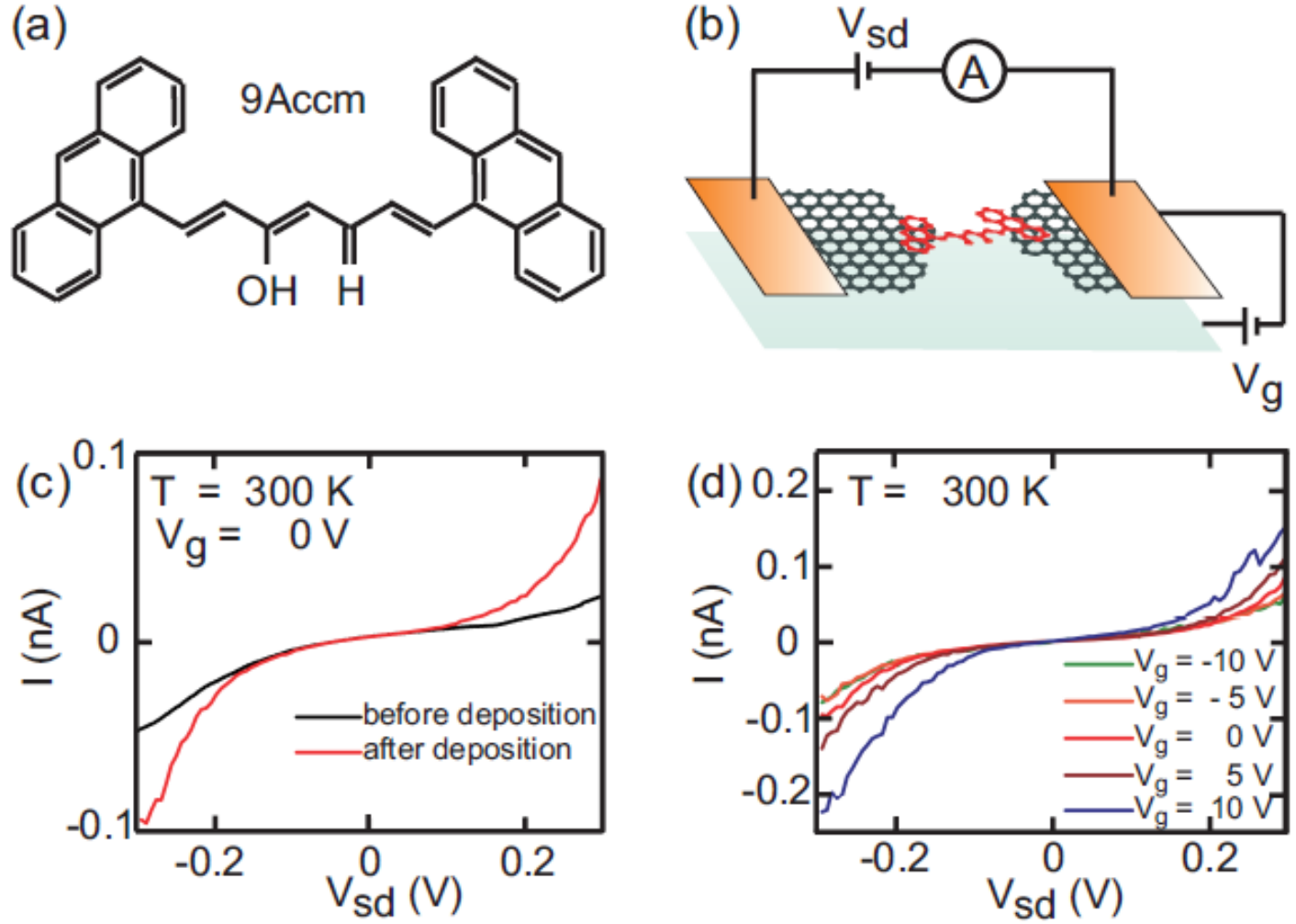
→can be used for the characterization of small molecules



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

Anthracene-funtionalized curcuminoid molecules deposited:

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



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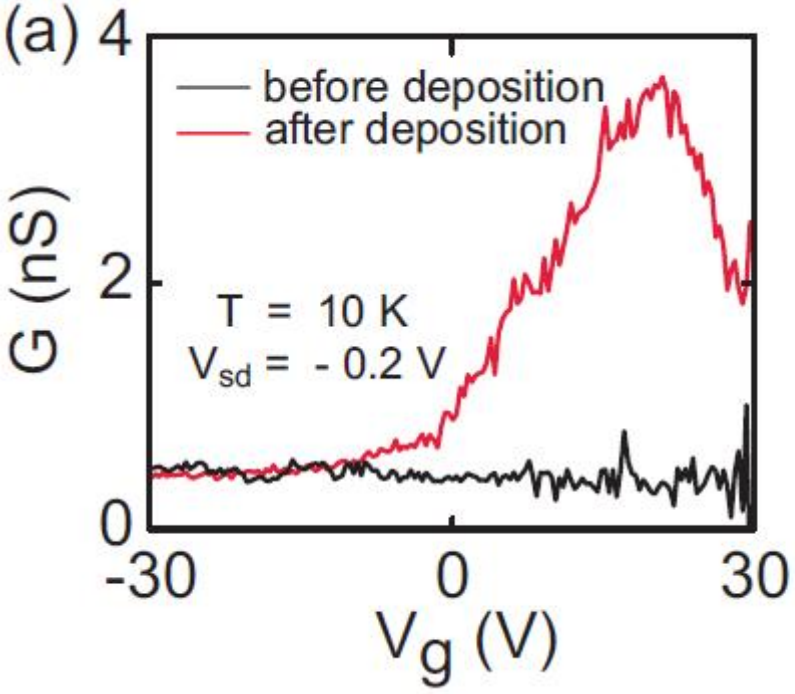

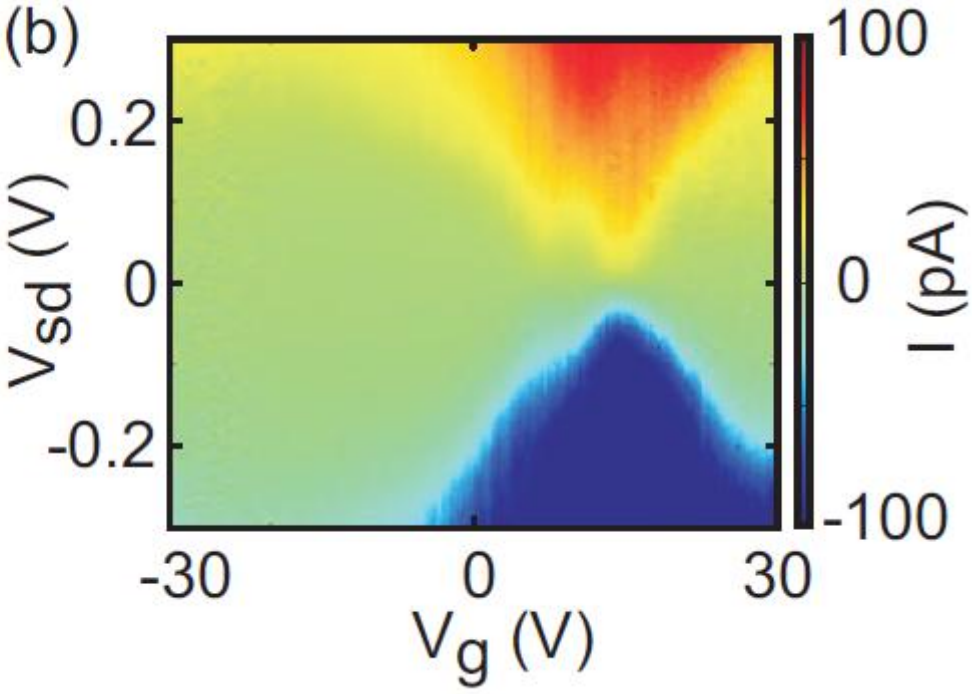

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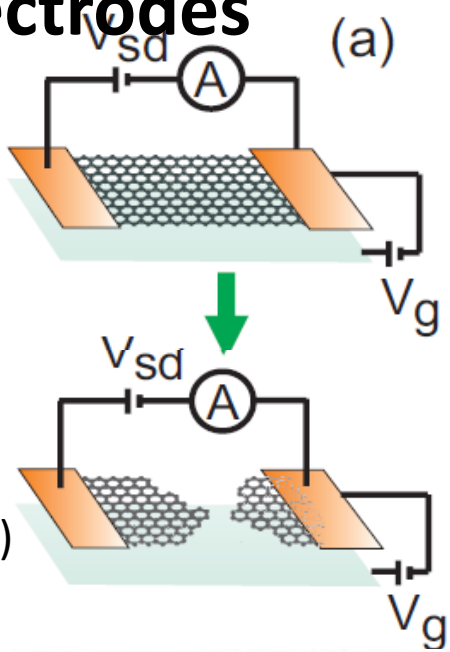

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