A FLEXIBLE GRAPHENE FET GAS SENSOR USING POLYMER GATE DIELECTRICS
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SUMMARY
This work demonstrates a graphene FET gas sensor on a flexible plastic substrate for the first time. Specific accomplishments include:
(1) utilizing polymeric material as the gate dielectric and channel dopant for graphene FET, respectively;
(2) a sensitivity of 0.00428ppm⁻¹ for ammonia
(3) a real-time gas sensing mechanism utilizing n-type doping of graphene induced by ammonia exposure

CONCEPT
Inorganic gate dielectrics on flexible substrates [1] often generates cracks within the crystal domain, resulting in device failures [2]. In this work we propose the use of organic parylene as the gate dielectric material and physisorption of PEI as chemical dopant (Fig 1a), with the graphene channel open to the environment for gas sensing on a flexible polyimide substrate (Fig 1b). Fig 2 shows the fabrication process.

FABRICATION
Fig 3 shows the optical microscopic pictures of graphene FETs on silicon substrate and flexible substrate respectively. Fig 4 is the experimental characterization of contact angles as the thin PEI layer alters the surface contact angle from 85° of pristine graphene to 15°, and then a further Gamma-MPS treatment change the contact angle to 30°.

RESULT
I_DS-V_DS and I_DS-V_G responses from a prototype flexible GFET device validate the feasibility of using the proposed polymer layers as gate dielectrics materials (Fig 6). When exposed to 3500ppm of ammonia under different applied gate voltages, the peak of R_DS shown in Fig 7 gives a direct observation of n-type doping of graphene due to ammonia on a time-variant basis. Fig 8 shows the transient performance under different ammonia concentrations and the experimental setup.

REFERENCES
[J. Lee, ACS Nano, Aug 13, 2013, DOI: 10.1021/nn403487y