Electronic Supplementary Material (ESI) for Nanoscale

Few layer graphene to graphitic films: Infrared photoconductive versus bolometric response

Narendra Kurra, Venkata Srinu Bhadram, Chandrabhas Narayana and Giridhar U. Kulkarni *

Chemistry & Physics of Materials Unit and DST Unit on Nanoscience

Jawaharlal Nehru Centre for Advanced Scientific Research, Jakkur P.O., Bangalore 560 064, India

CORRESPONDING AUTHOR FOOTNOTE

***Author correspondence:** kulkarni@jncasr.ac.in

Fax: +91 (80) 22082766

Phone: +91 (80) 22082814

Electronic Supplementary Information (ESI)

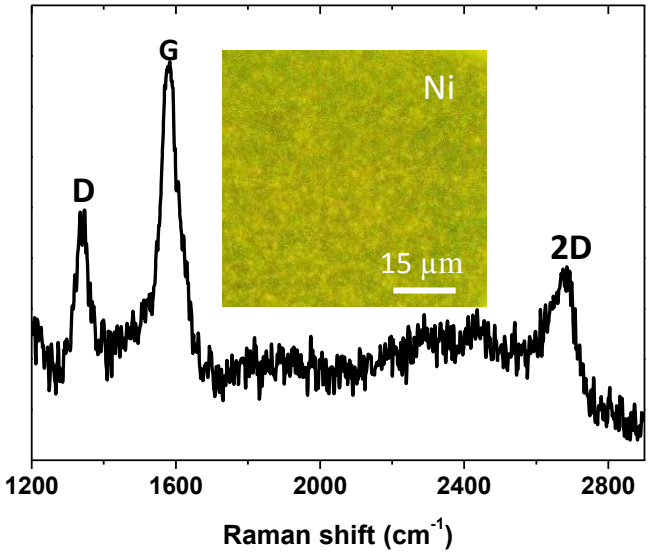

Fig. S1 Raman spectrum of the precipitated few layer graphene on the Ni surface after thermal annealing (1000 ºC, 15 min) in presence of residual hydrocarbons abundant in the vacuum chamber. The noise in the spectrum is due to the specular reflections from the Ni metal surface.

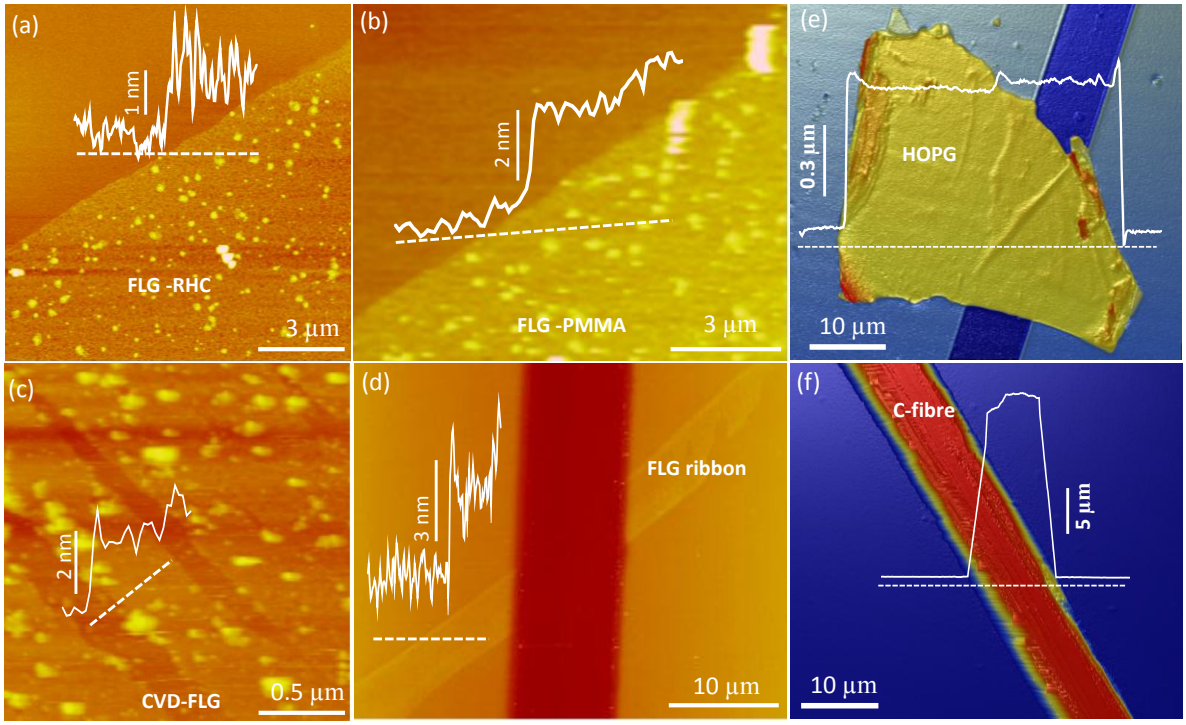

Fig. S2 AFM topography of the FLG-RHC (thickness ~1.3 nm) (a), FLG-PMMA (~2.2 nm) (b), CVD-FLG (~2.5 nm) (c), scotch-FLG (~3 nm) (d), bulk graphite piece (~600 nm) (e) and carbon fibre (~18 µm) (f) respectively. The corresponding z-profiles are provided.

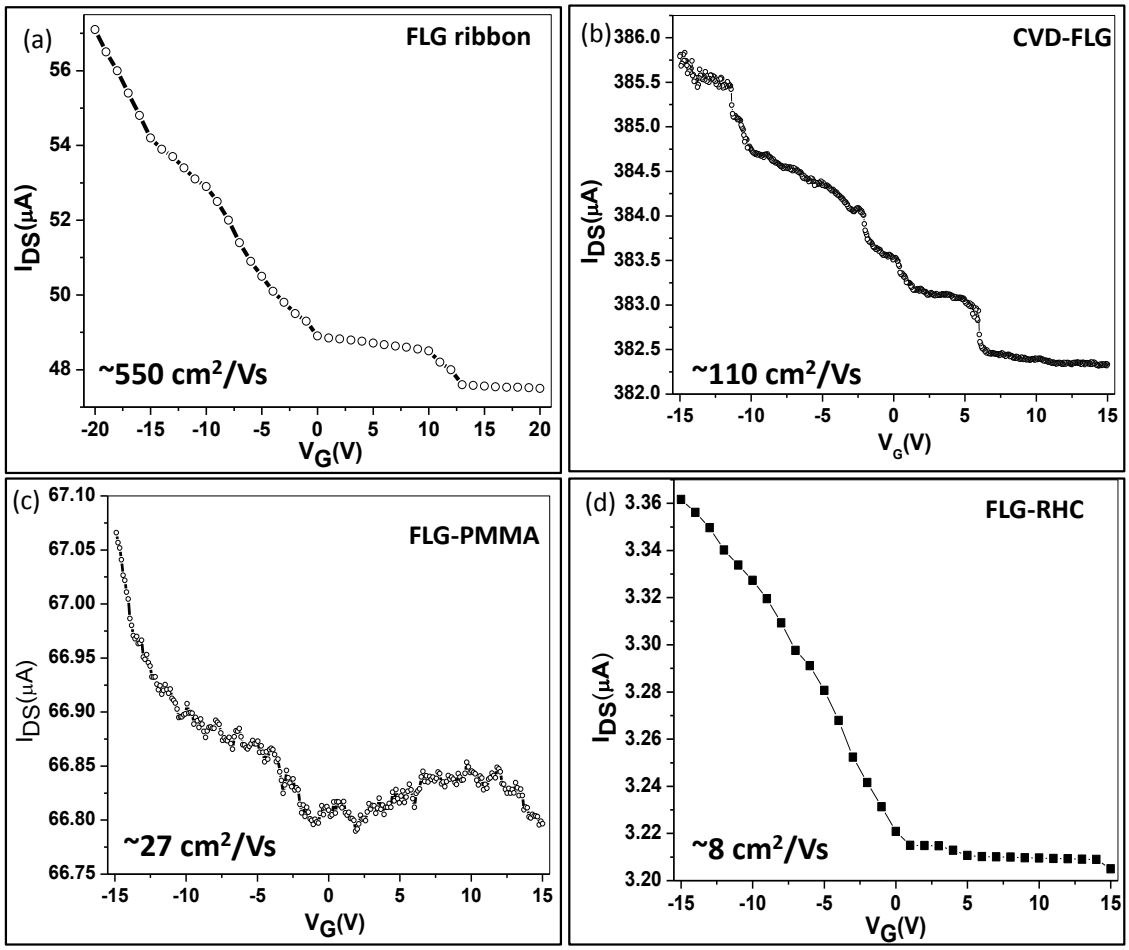

Fig. S3 (a-d) Transfer curves for the FLG derived from different methods. Hole Mobilities are calculated from the transfer curves are found to be 550, 110, 27 and 8 cm^2/Vs for the FLG ribbon, CVD-FLG, FLG-PMMA and FLG-RHC respectively. SiO_2 (300 nm) was used as the bottom gate dielectric (specific capacitance, 12 nF/cm^2). Source-drain voltage (V_{DS}) was 0.1 V in all the measurements.

The mobilities are calculated from the transconductance values

$g_m = (dI_{DS}/dV_G) = (W/L)\mu C_o V_{DS}$

where W and L are the width and length of the channel.

μ is mobility.

C_o is the specific capacitance ~12 nF/cm^2.

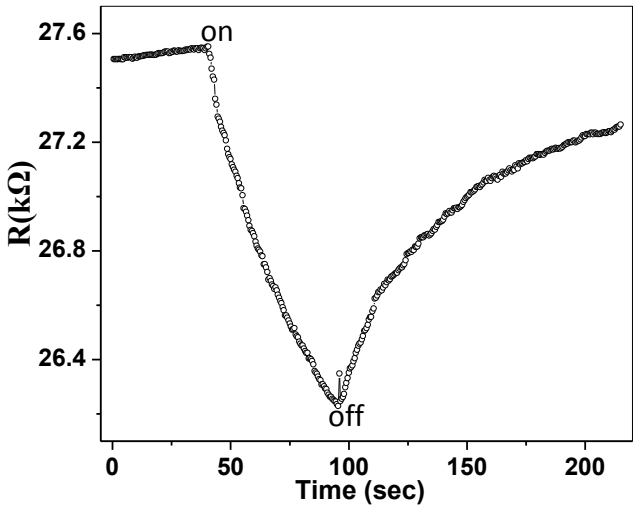

Fig. S4 Decrease in the resistance of the FLG-RHCs towards the IR radiation (source: incandescent bulb, 60 W at a distance of 15 cm).

The above plot illustrates the sensitivity of RHC-FLG with respect to IR radiation from an incandescent bulb. The temperature near the circuit was found to be 40-50 ºC. It is noteworthy that our FLG circuits showed a response to the IR radiation emitted from an incandescent bulb as well (surrounding temperature was ~ 40-50 ºC).

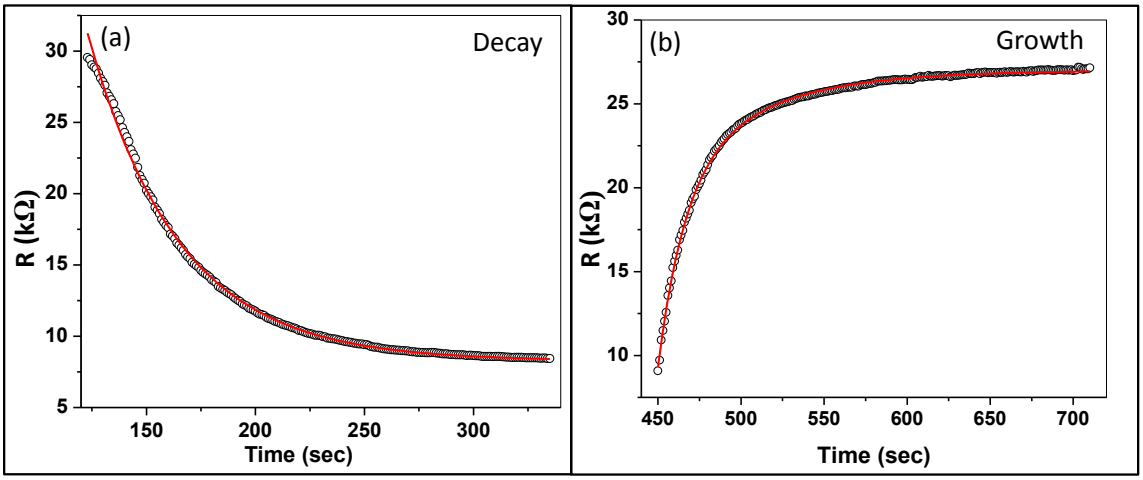

Fig. S5 (a) and (b) Fall and rise of the resistance with respect to turning on and off of the IR beam.

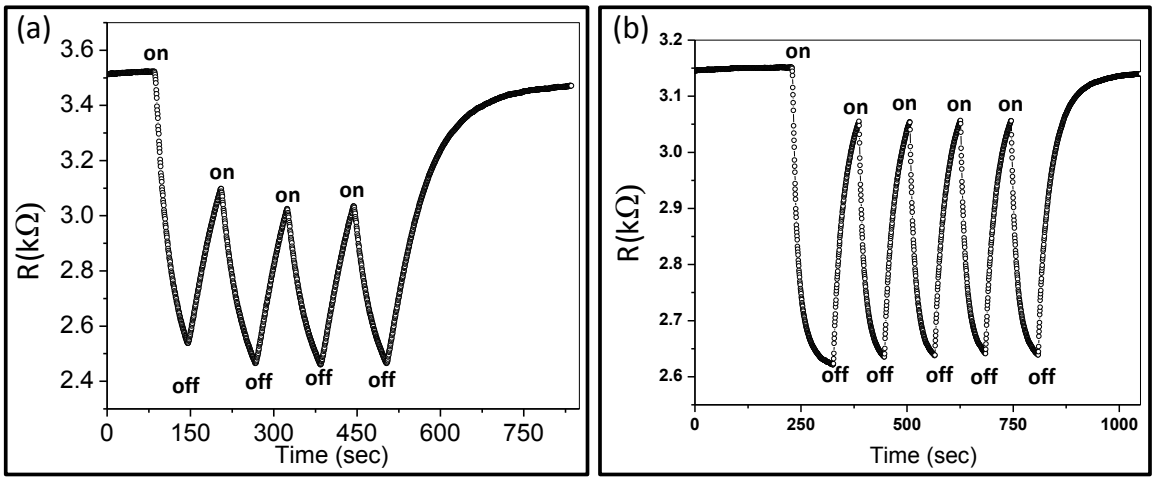

Fig. S6 (a) and (b) IR photoresponse of the RHC-FLG on the quartz and sapphire substrates respectively. The photoresponses are found to be 37% and 25% respectively.

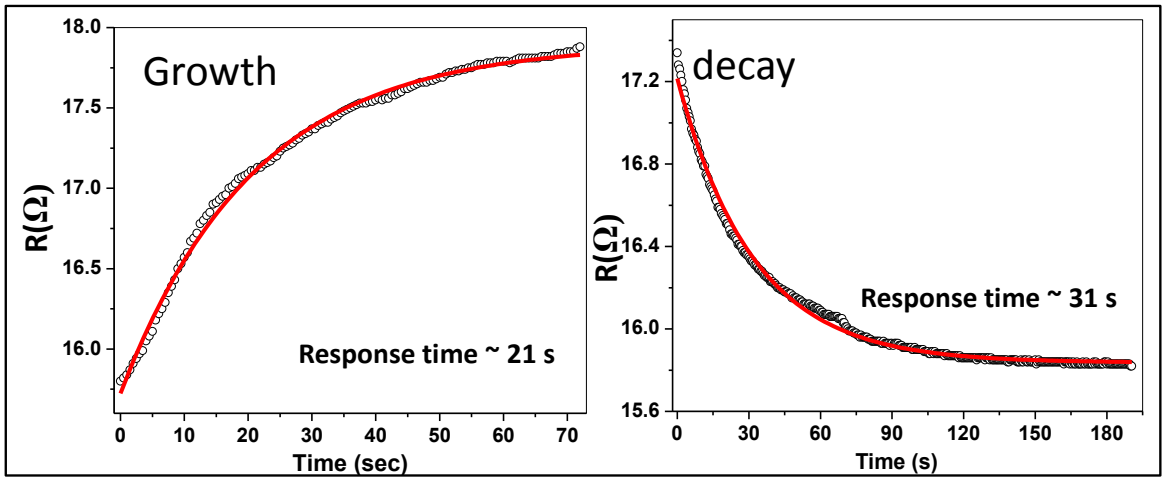

Fig. S7 Rise and fall in the resistance for the bolometric response of the bulk graphite samples fitted to exponential behavior. Response times are found to be 21 and 31 seconds for the rise and fall curves respectively.

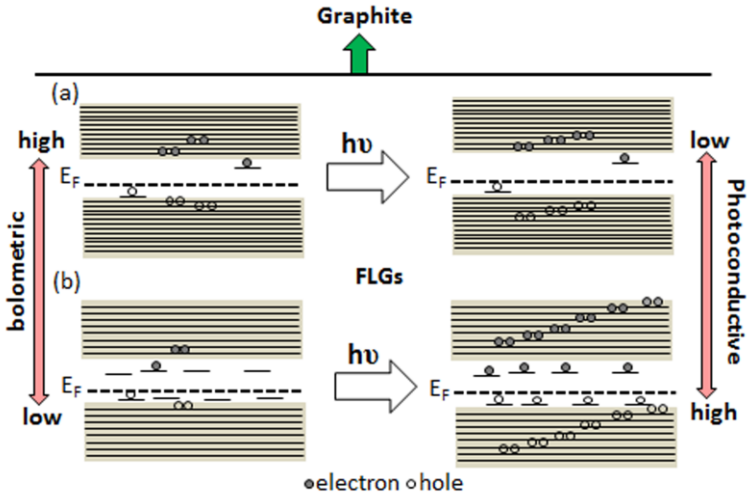

Fig. S8 Schematic illustration of energy level diagrams and charge carrier excitations under an applied bias, for FLG with (a) less and (b) more number of localized defect states which are shown with short lines (-) above and below the E_F. The band gap is typically few meV. The situations favoring the photoconductive and bolometric responses are indicated.