IOCN 2020

2nd International Online-Conference on Nanomaterials

15–30 NOVEMBER 2020 | ONLINE

Multilayer graphene supported flexible optoelectronic devices

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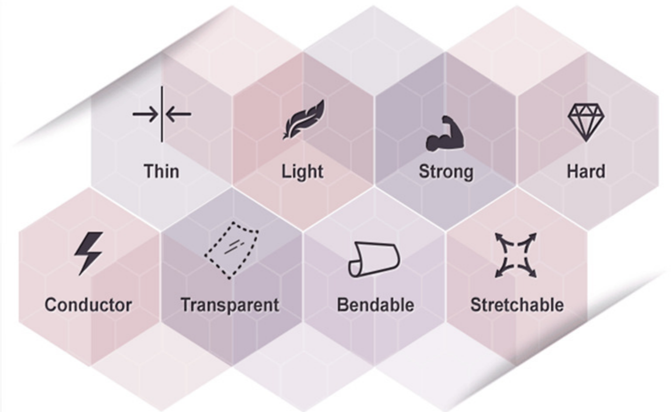
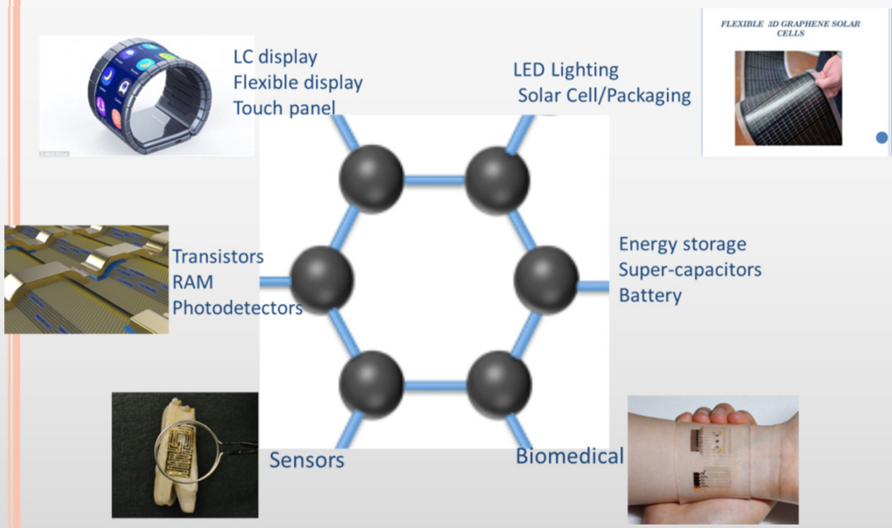
GRAPHENE PROPERTIES AND APPLICATIONS



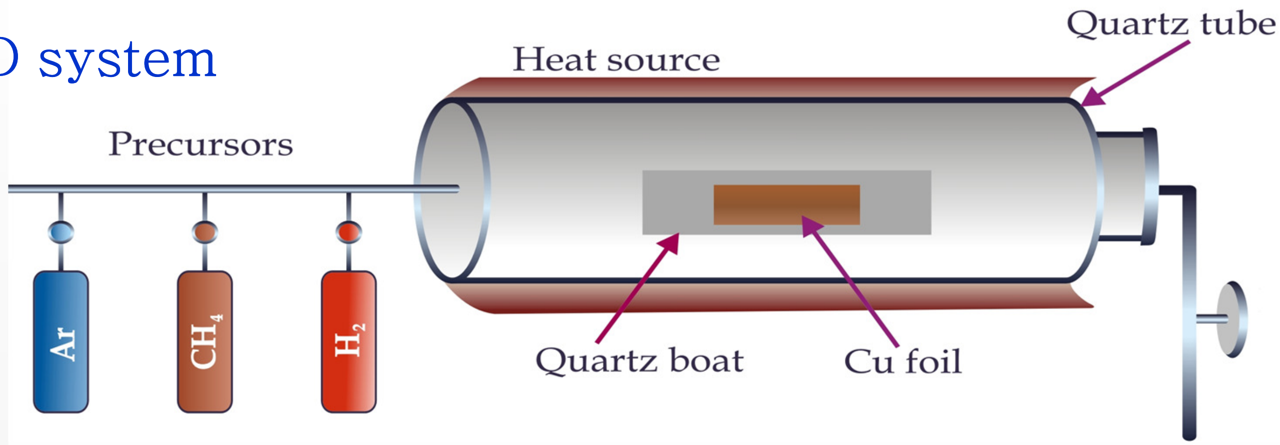
- A sheet of a single layer (monolayer) of carbon atoms, tightly bound in a hexagonal honeycomb lattice. Only one atom thick ~ 0.335 nm (*therefore called "2D"*);
- High transparency and excellent conductivity at the same time (*absorbs only 2.3% of reflecting light)*;
- Highest electron mobility of all electronic materials (*100x faster than silicon)*



- Extremely hard (*harder than the diamond and 100 times harder than the steel)*;
- Resistivity – 1×10^{-8} Ω.m among the lowest of any known material at room temperature *(~35% less than copper);*
- Excellent candidate to replace the widely used ITO conductive electrodes;
- Thermal conductivity – 3000-5000 W/mK at room temperature *(2x higher than diamonds)*;
- Flexibility: great potential for bendable, light and thin devices, ultra small transistors.

GRAPHENE GROWTH by APCVD

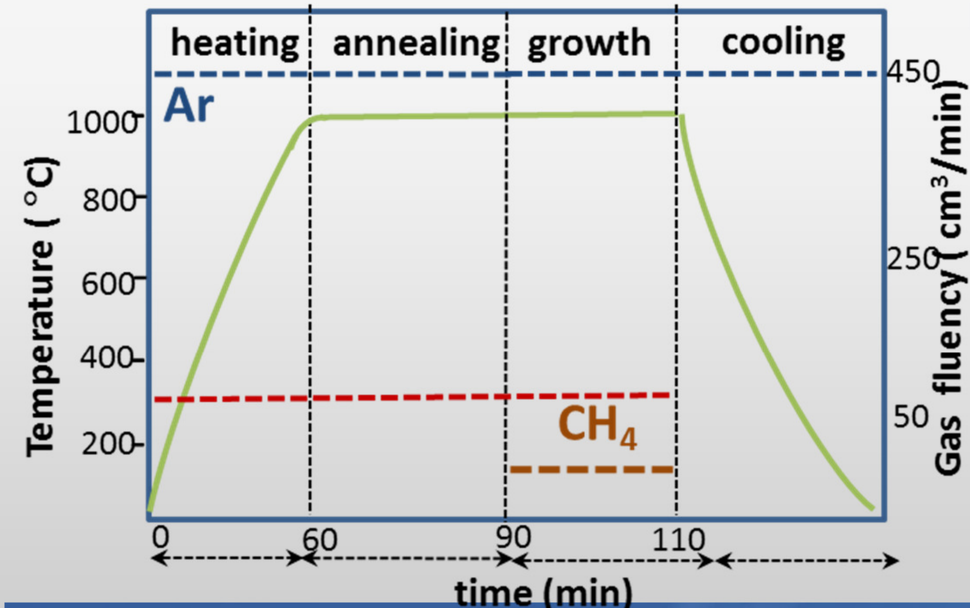
1. APCVD system



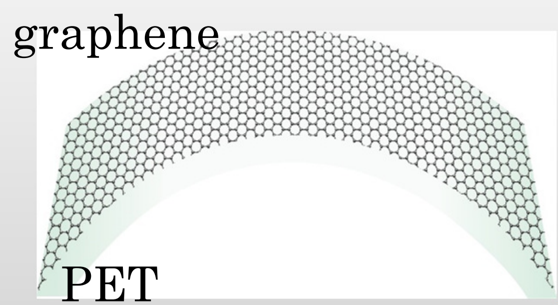
Copper foil (Alfa Aeser 99.8% purity, 25 μm thickness)

2. Temperature diagram

$Ar:H_2:CH_4$–450:50:10 cm^3/min

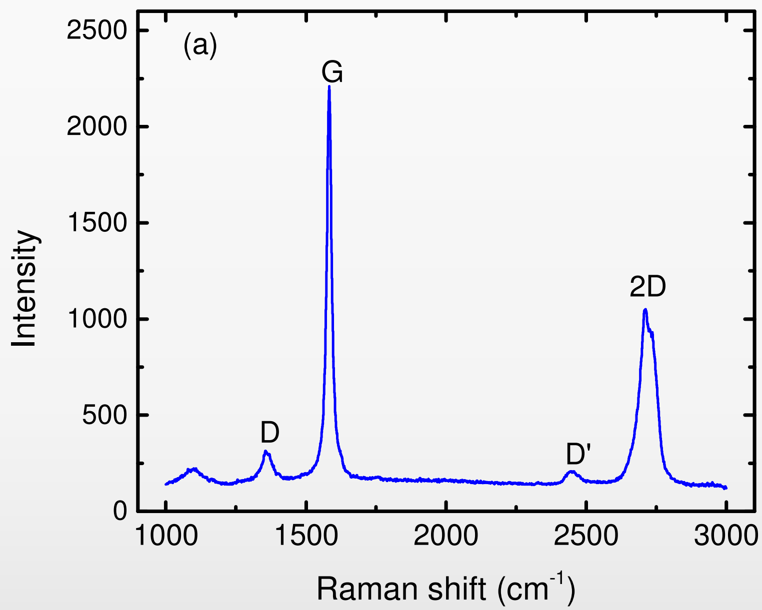


3. Graphene transfer on PET



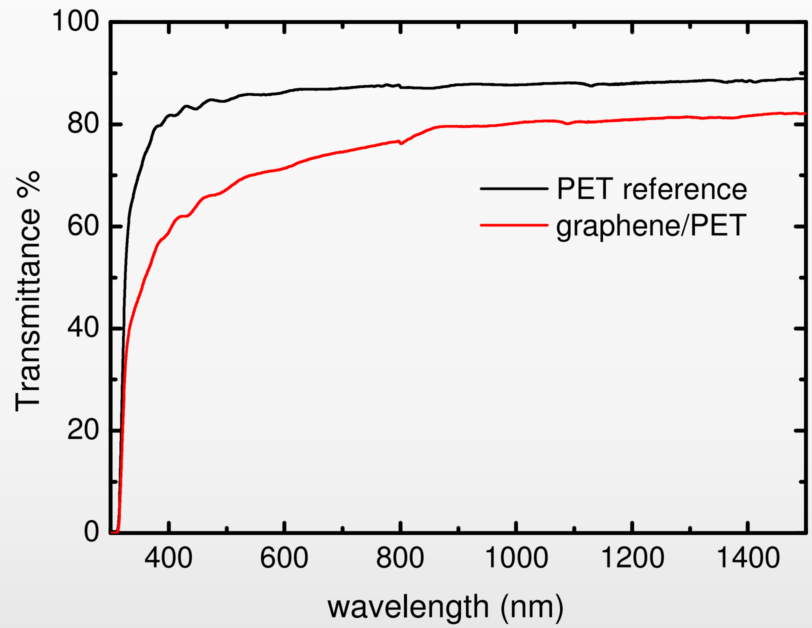
EXPERIMENTAL RESULTS

Raman analysis



Raman spectrum, characterized with very strong G peak (at ~ 1582 cm^{-1}) and 2D peak (at ~ 2718 cm^{-1}) with I(2D)/I(G) of ~ 0.474.
D peak (at 1350 cm^{-1}) with moderate intensity, indicating formation of 4 to 5 layers graphene

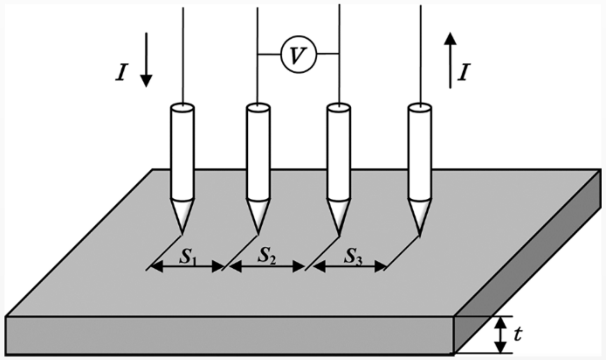
Transmittance

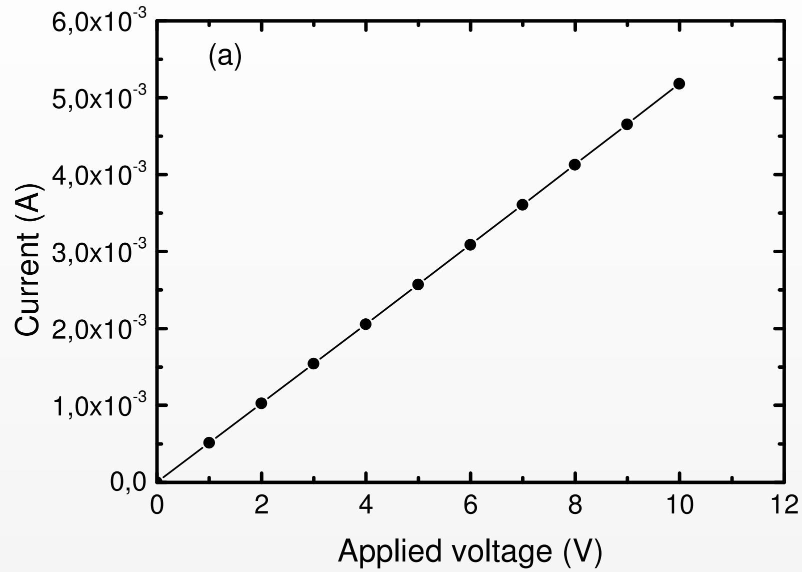


Optical transmittance spectrum of graphene/PET at visible and near infrared spectral range

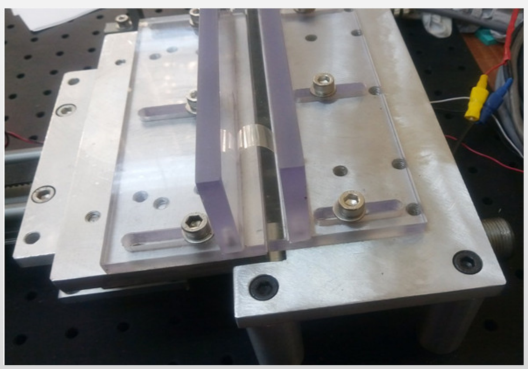
EXPERIMENTAL RESULTS

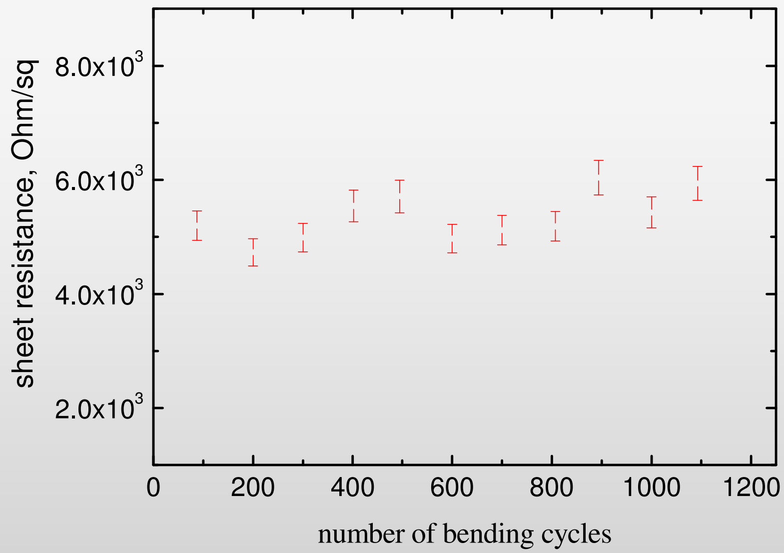
Electrical properties





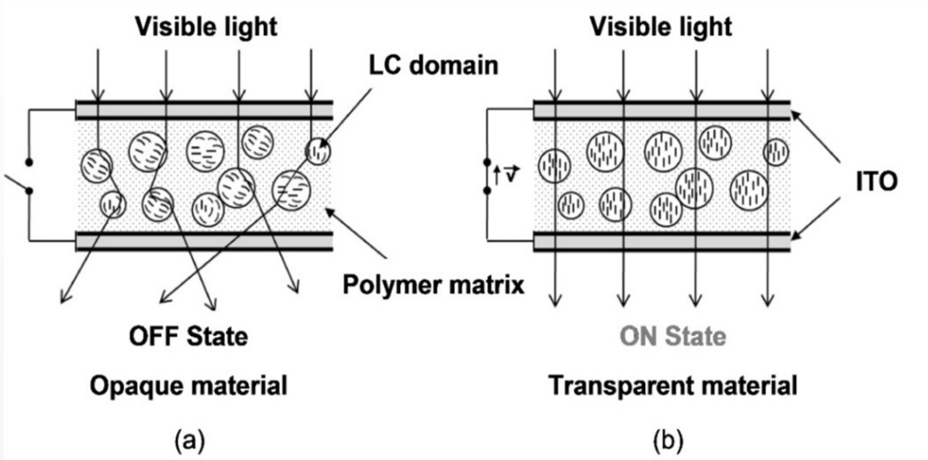
Bending test ability

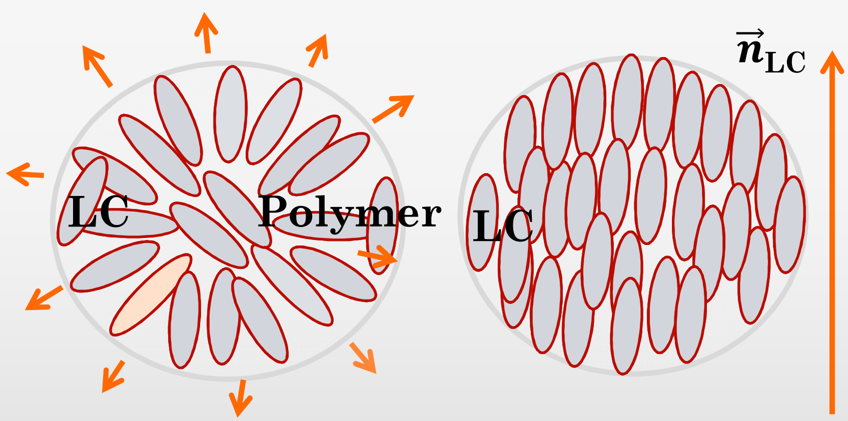




Remarkable sheet resistance stability under bending of graphene

PDLC principle of work. Graphene/PET PDLC device assembly





$E_{extn.} = 0$ $E_{extn.} \neq 0$

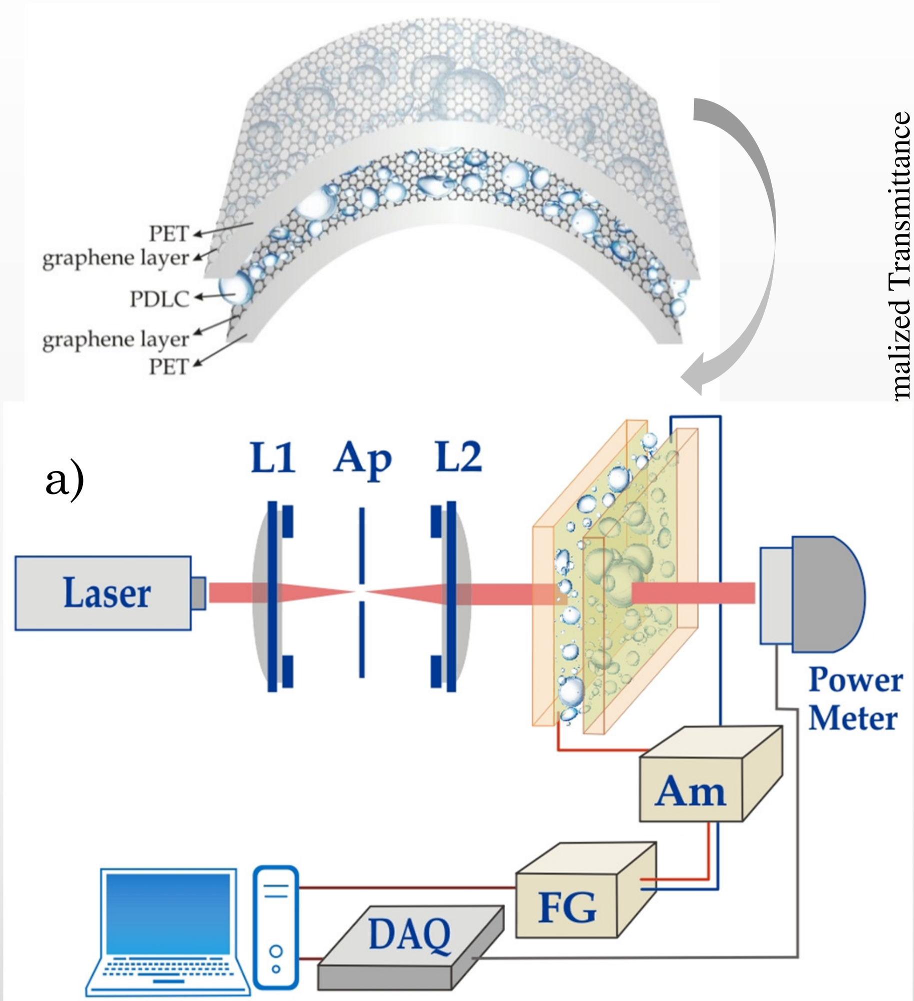
n_{LC}–randomly oriented $n_o = n_p$ – become transparent

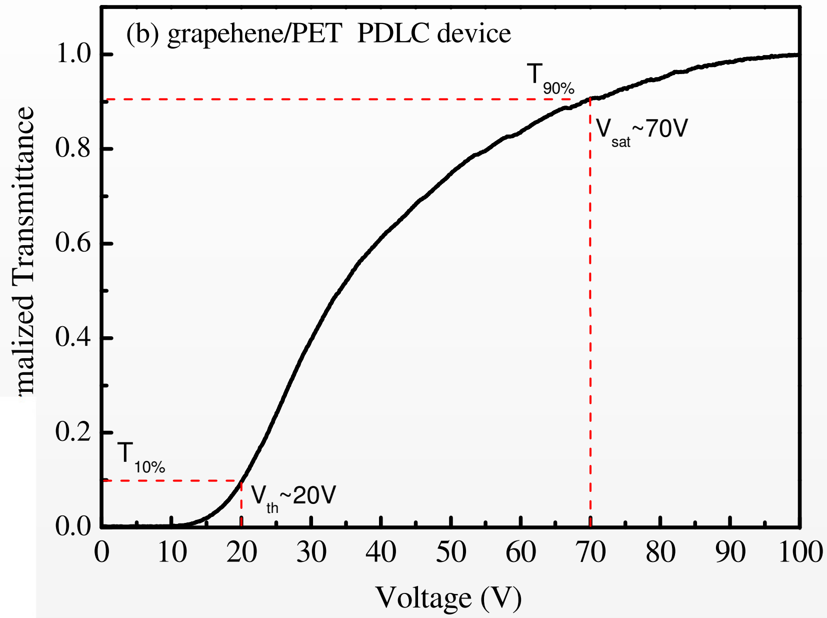
“On” state

https://www.indiamart.com/

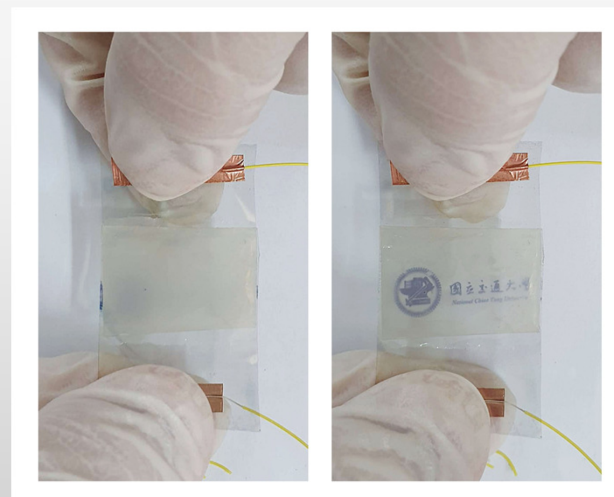
- PDLC - composite mixture of LC molecules randomly dispersed in a solid polymer matrix.
- Naturally opaque due to the refractive index mismatch between the polymer matrix and LC.
- Can be switched from opaque to transparent state by application of E_0, which supports the refractive indices match between the LC molecules and the polymer.

Electro-optical characteristics of graphene/PET DPLC device

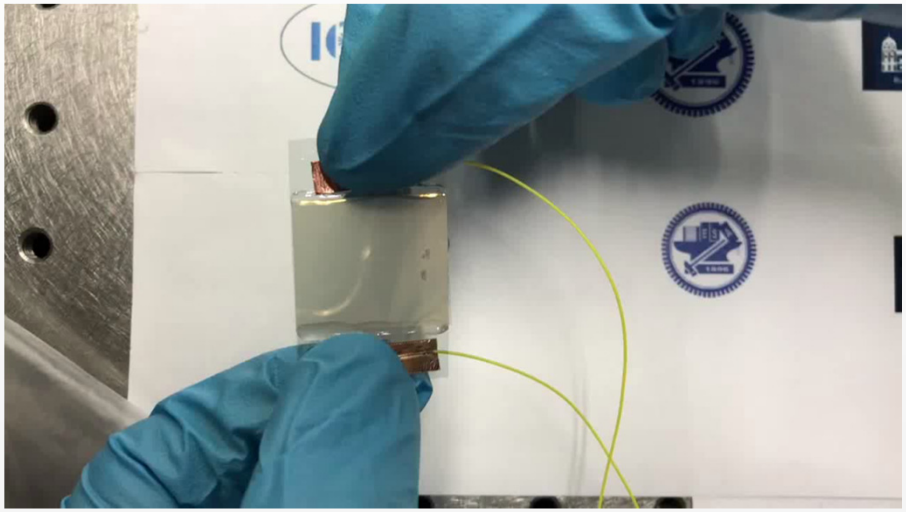


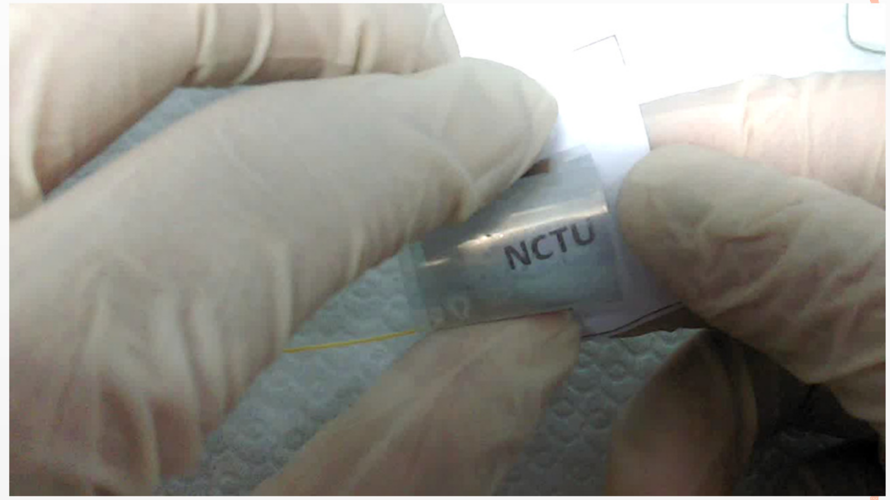


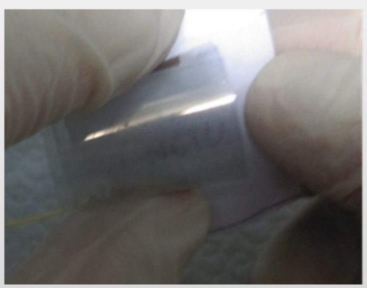
c)

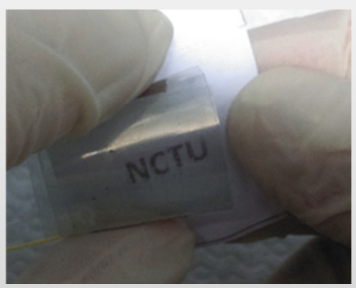


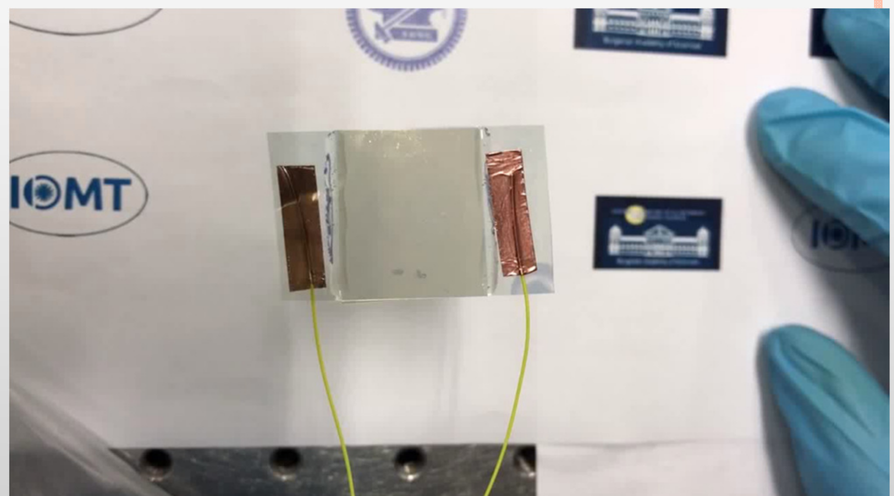
(a) Experimental set-up to measure Voltage-Transmittance (V-T) behavior (b) V-T curve characteristic and (c) “on” and “off” states of graphene/PET PDLC device











Bending ability of graphene/PET PDLC device

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Thank you for your attention!