

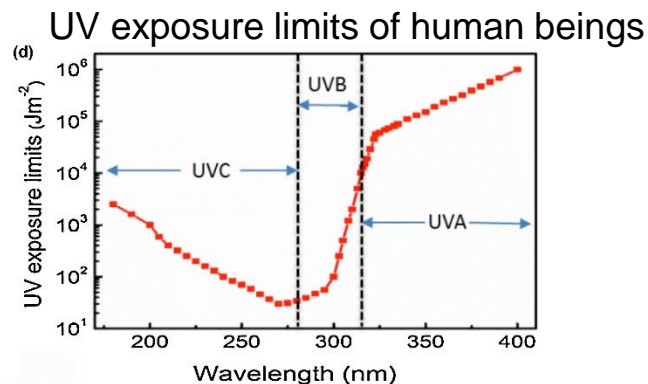
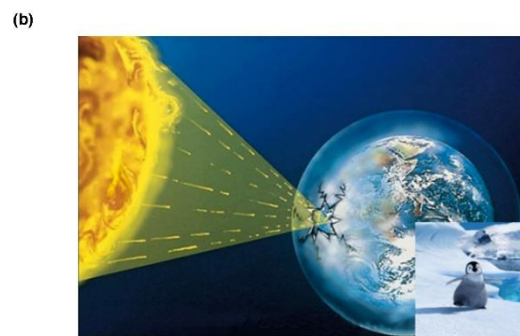
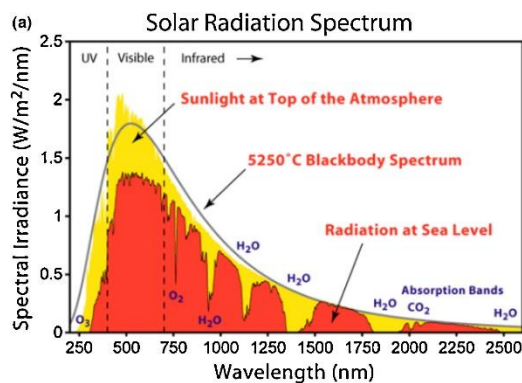
Self-powered AlGaIn based Visible-Blind UV Detector with 2DEG and Graphene transporting layers

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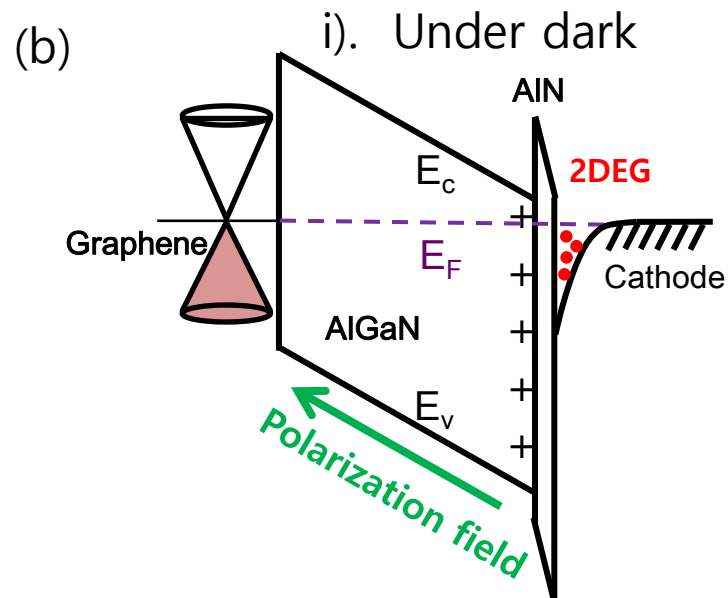
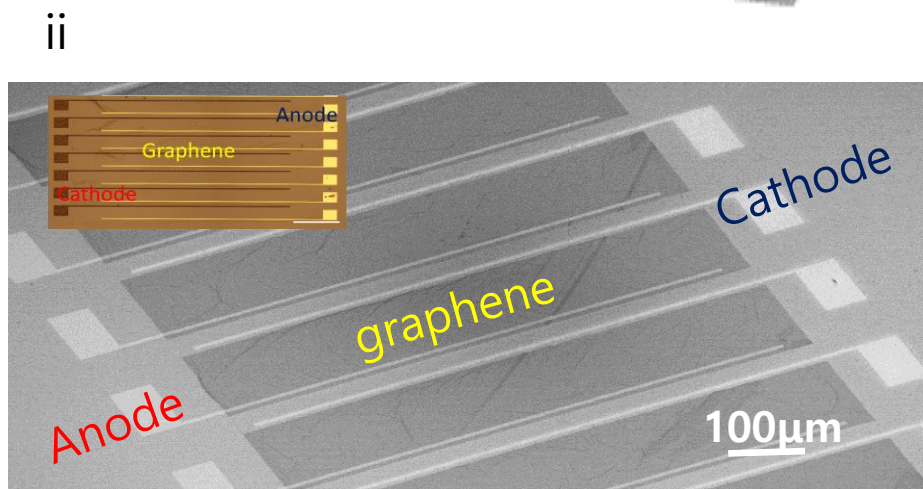
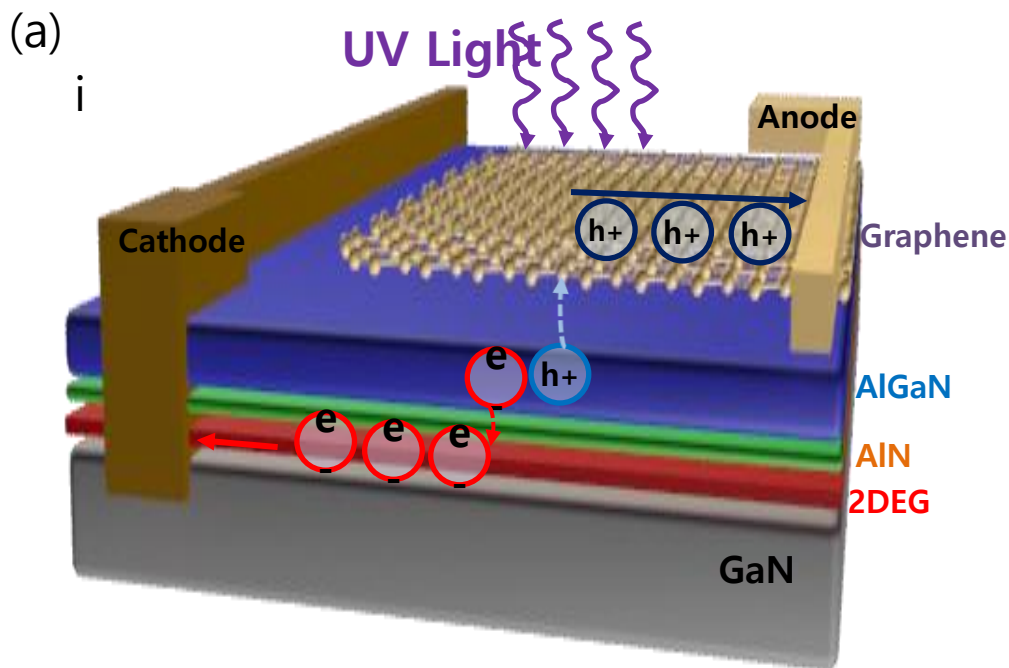
2018-07-12

- Photodetection of the deep ultraviolet (DUV) light free of environment noise.
 - Flame detection
 - Health and Environment monitoring (Ozone hole)
 - Advanced communication

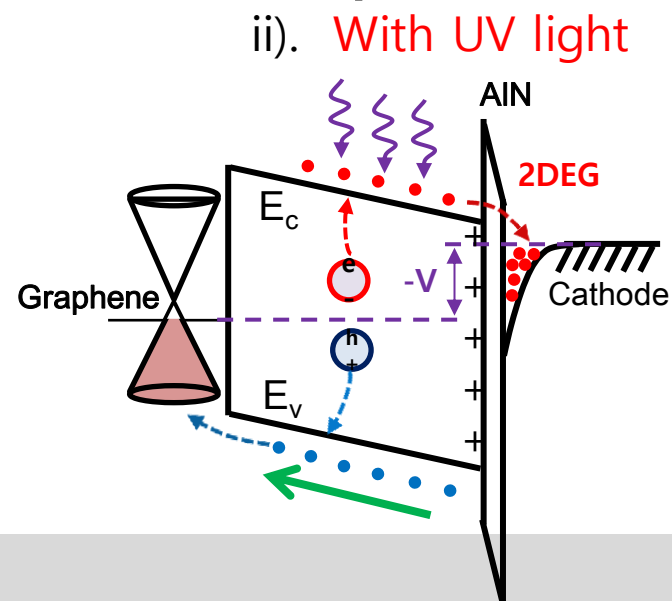


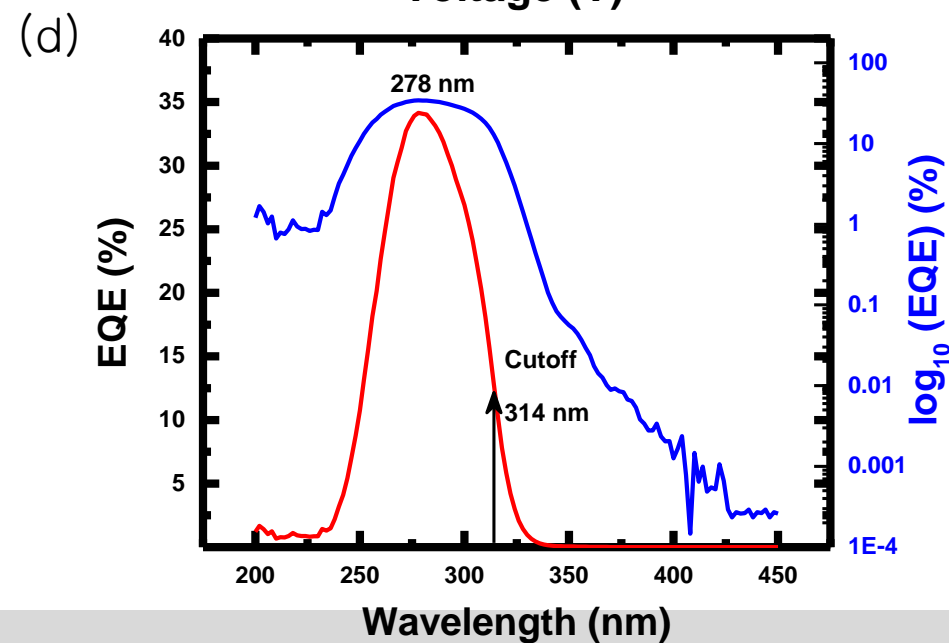
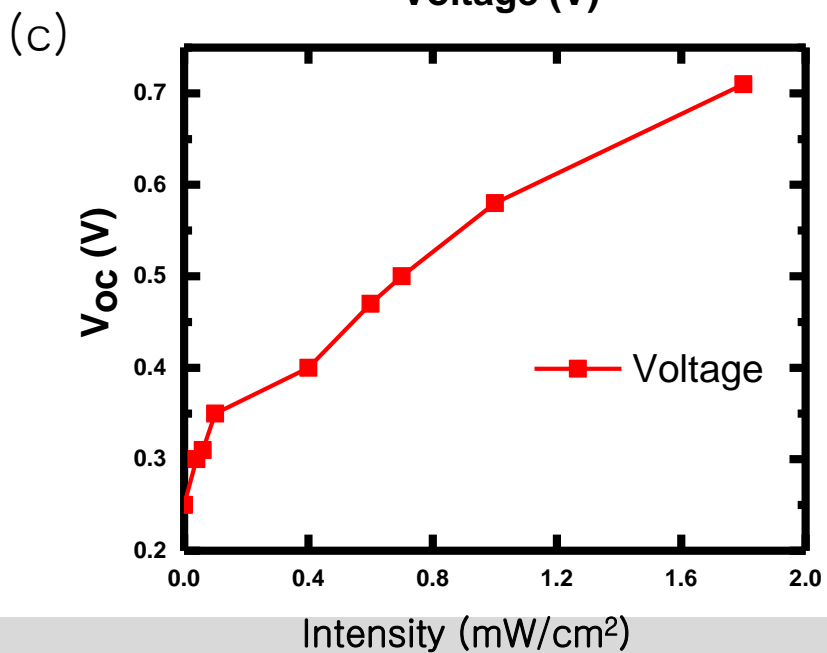
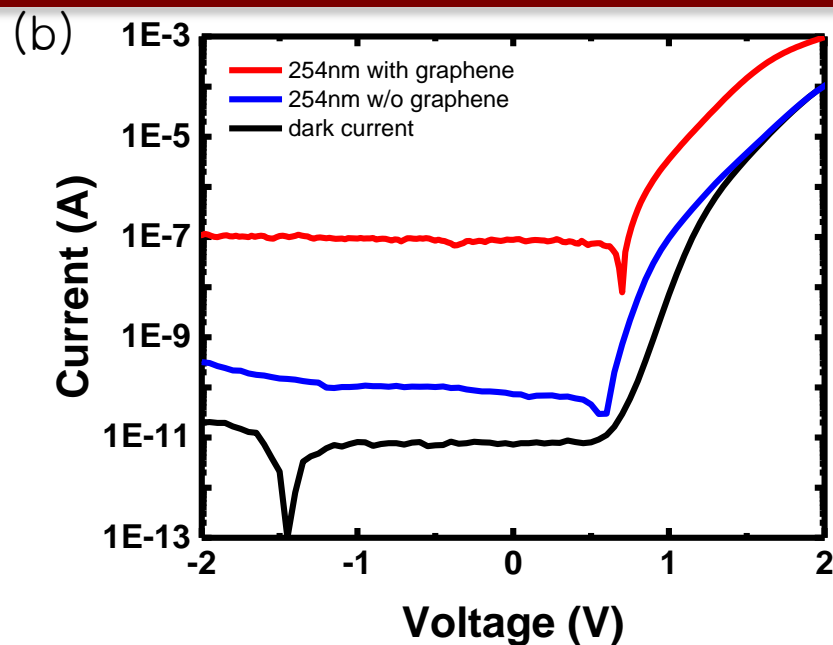
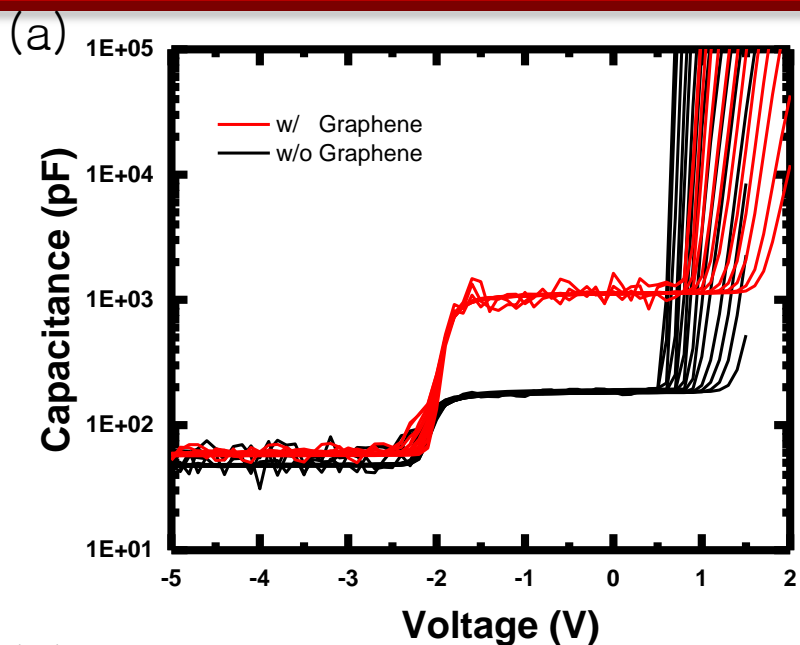
A.F. McKinlay, *et al.* Health Phys., 87 (2) (2004), pp. 171-186

- Al_xGa_{1-x}N (3.3 ~ 6.1 eV)
 - Epitaxial growth capability in wafer scale
 - Tunable bandgap
- Desired features for unattended and intelligent UV photodetectors
 - Self-powered
 - → Intrinsic polarization field of Nitride group materials
 - High responsivity and large specific detectivity
 - → Graphene as transparent contact
 - Fast transient response
 - → highly conductive carrier transport layers (graphene for hole and 2DEG for electrons)
 - Spectrum selectivity

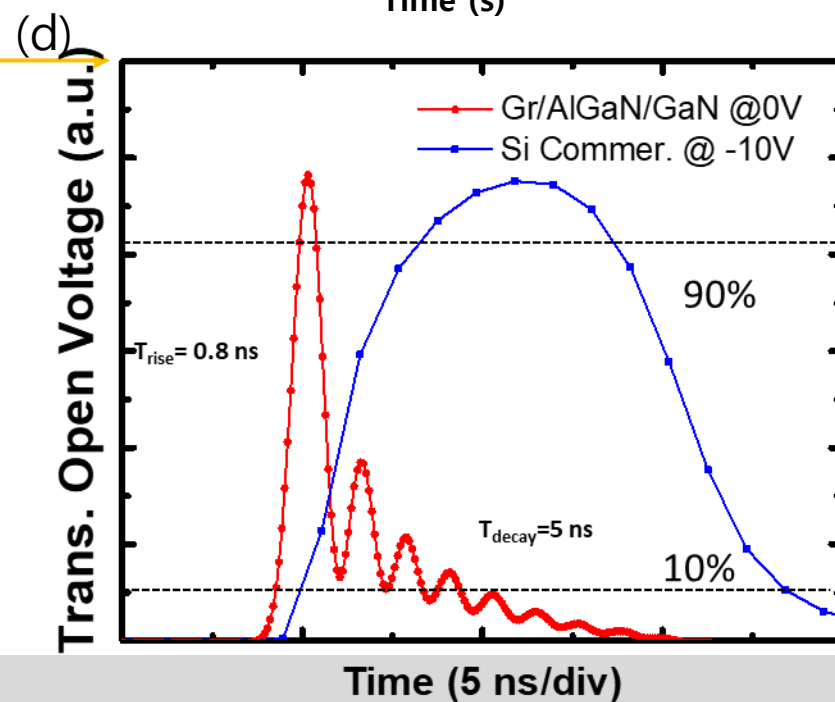
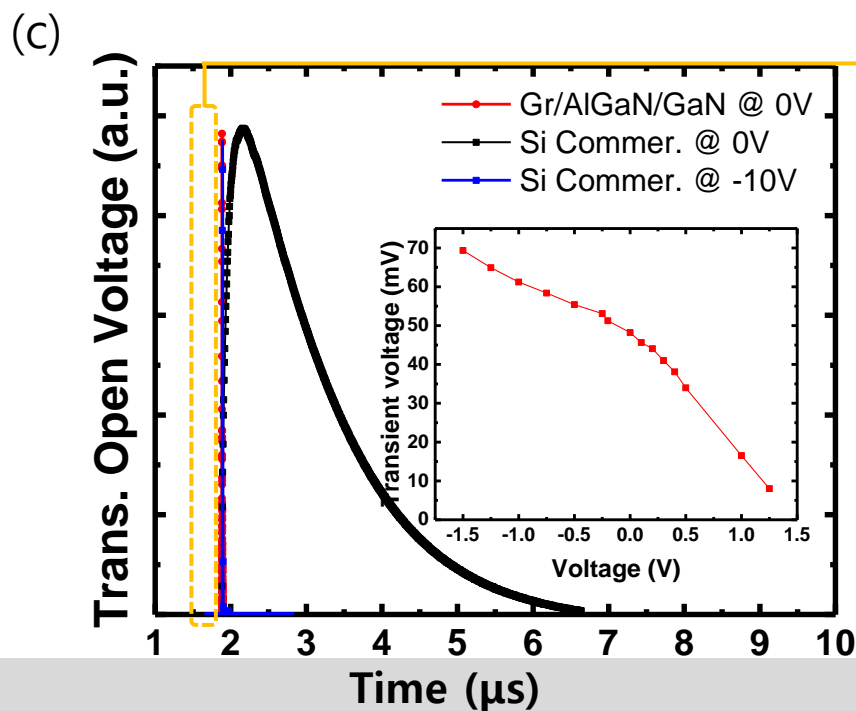
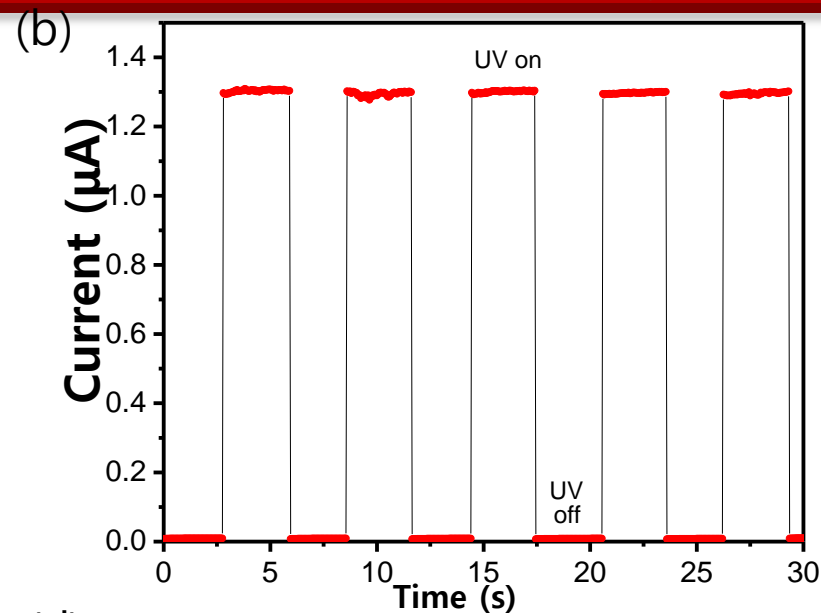
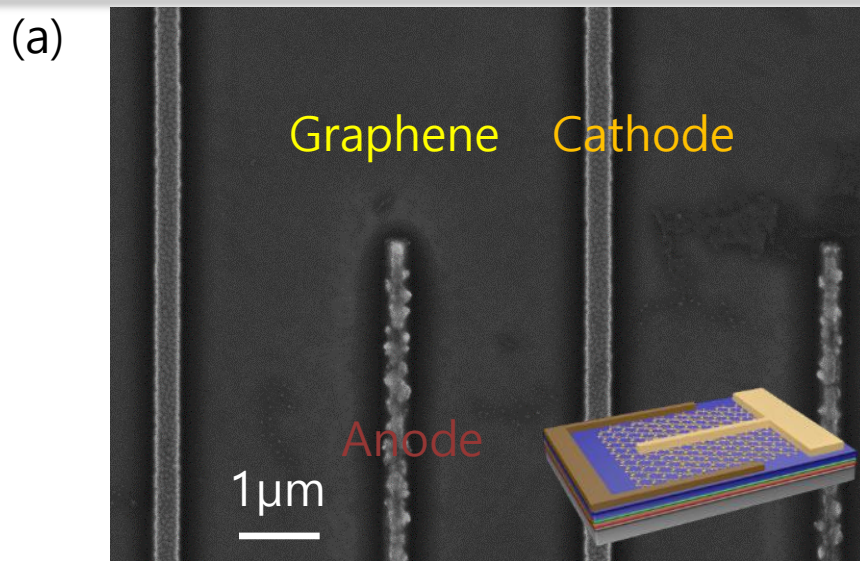


Self-powered





Transient response



Comparison with state of art self-powered DUV PDs

Materials	structure	Detection wavelength peak	R _{peak} /R _{400nm}	Responsivity (mA/w)	Detectivity (Jones)	Rise time/Decay time	Ref.
ZnO/Ga ₂ O ₃	Microwires	251 nm (UVC)	6.9×10^2	9.7	6.3×10^{12}	100 us/900 us	[4]
Au/Ga ₂ O ₃	Nanowire Schottky diode	258 nm (UVC)	38	0.01	-	1 us/100 us	[7]
Polyaniline/MgZnO	Thin film p-n junction	250 nm (UVC)	$\approx 10^4$	0.16	1.5×10^{11}	<0.3s/<0.3s	[8]
p-GaN/ZnO	p-n diode	358 nm (UVA)	≈ 10	0.65	-	-	[5]
β -Ga ₂ O ₃ /Ga:ZnO	Thin film n-n heterojunction	254 nm (UVC)	$> 10^2$	0.763	6.9×10^2	179ms/272ms	[6]
AlGaIn/AlN/GaN	Vertical epitaxy	279 nm (UVC)	1×10^4	76	8.3×10^{11}	0.8ns/5ns	This work

- **Self-powered** detectors on the AlGaN/AlN/GaN employing the intrinsic polarization effect.
 - No external extraction field needed to collect the photocarriers with open voltage of 0.7V.
- Graphene and 2DEG as **highly conductive carrier transport layer**.
- UV/visible rejection ratio of 10^4 , and **fast response** at 0 bias.
- **Readily to be integrated** with matured AlGaN/GaN high electron mobility transistor (HEMT) devices epitaxial and fabrication.



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Figure S3.



Figure S3. Camera Image of transparent graphene/AlGaIn with embedded GaN 2DEG released and transferred on PET Film with bending radius=18.5mm.