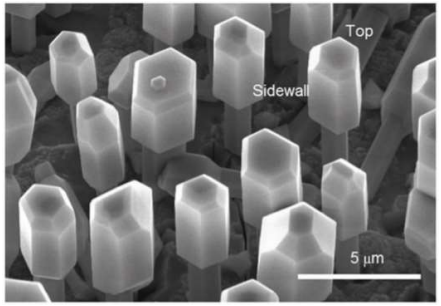
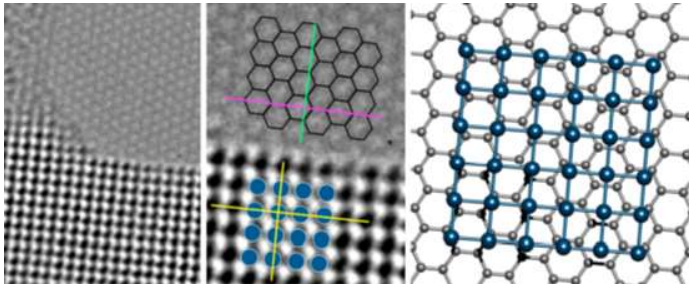
5. Production of 2D Materials
Part 3

Productions of 2D Materials





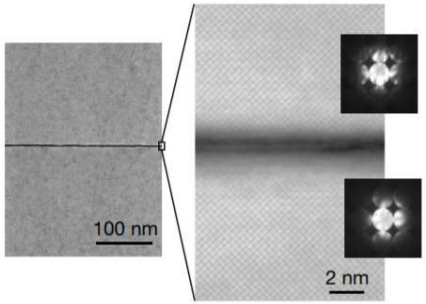
Metal

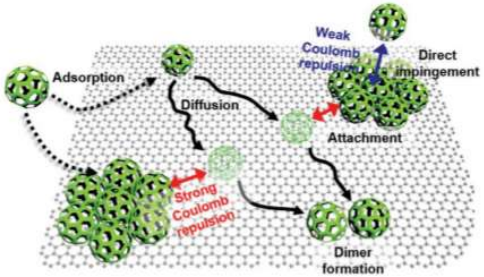
(In-)organic material

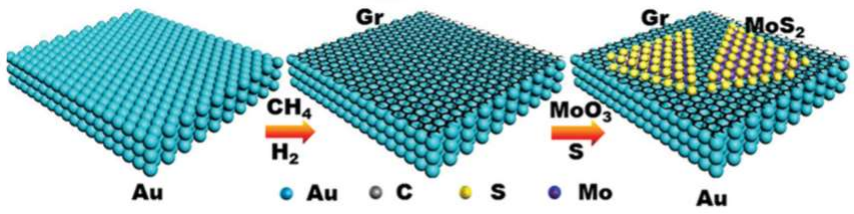
Graphene Template

Epitaxial growth

2D material growth

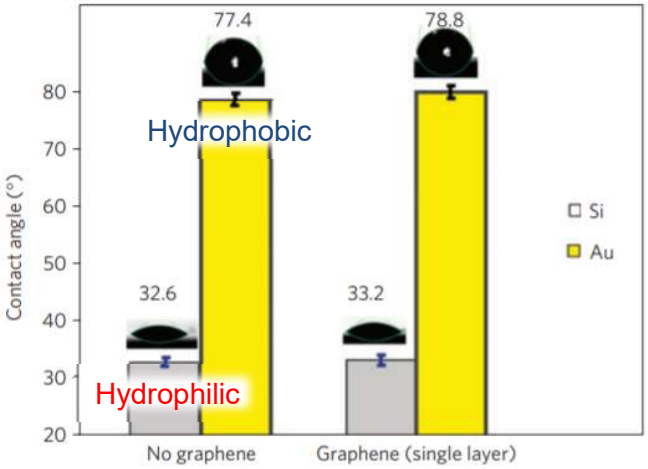


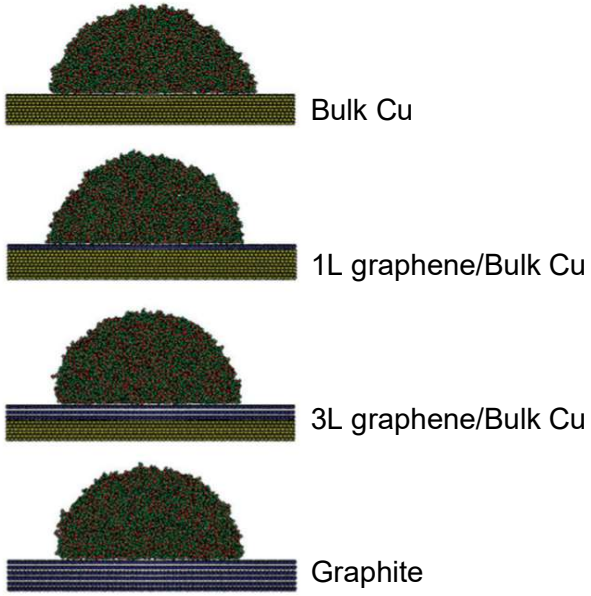




Surface Properties of Graphene

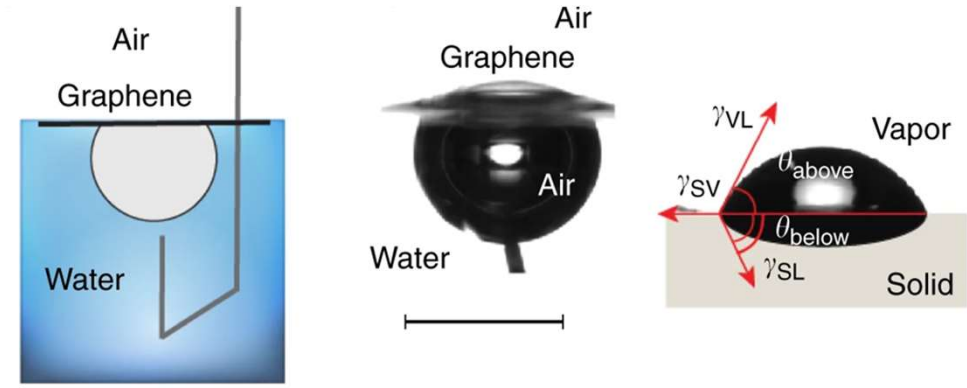
Wetting transparency of graphene



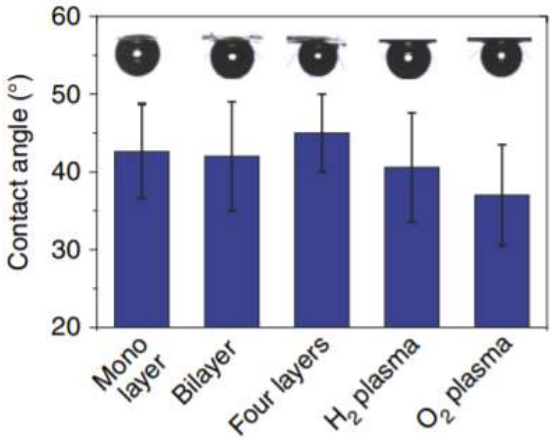


Nature Materials 11(3), 217–222 (2012)

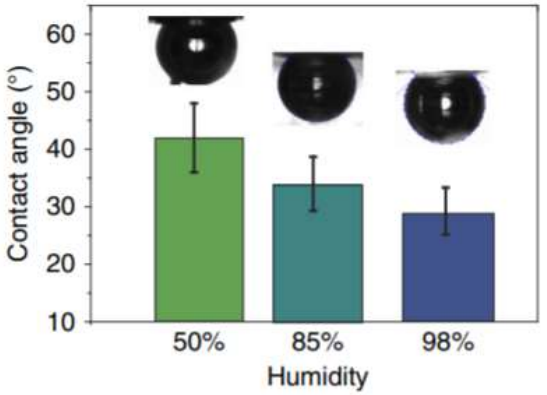
Contact angle of graphene



Hydrophilic graphene surface



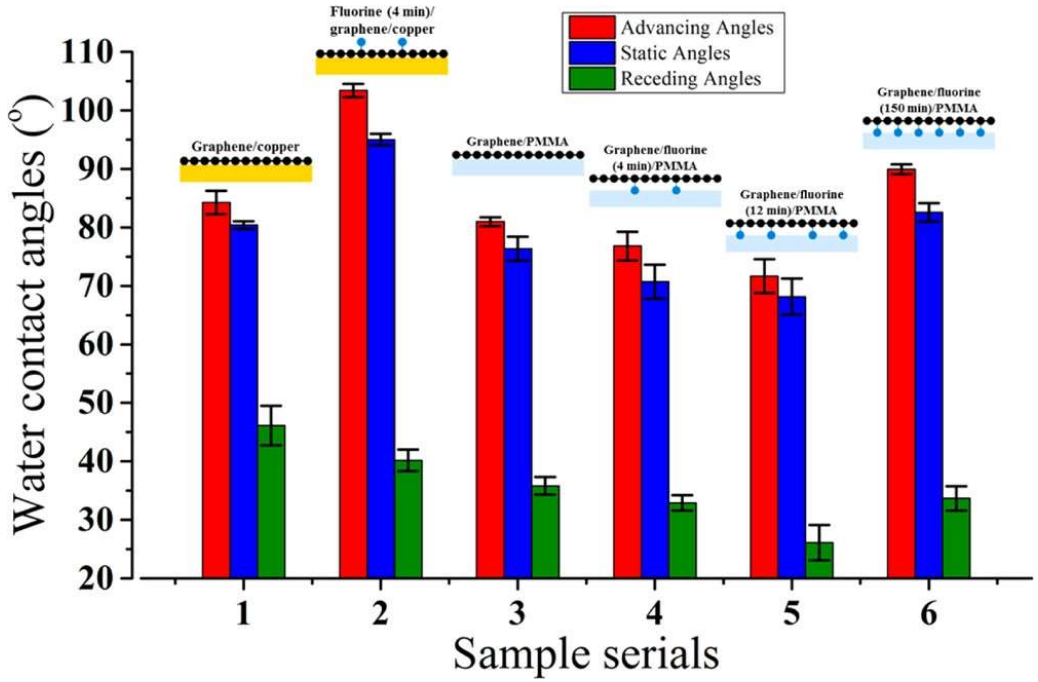
Humidity effect



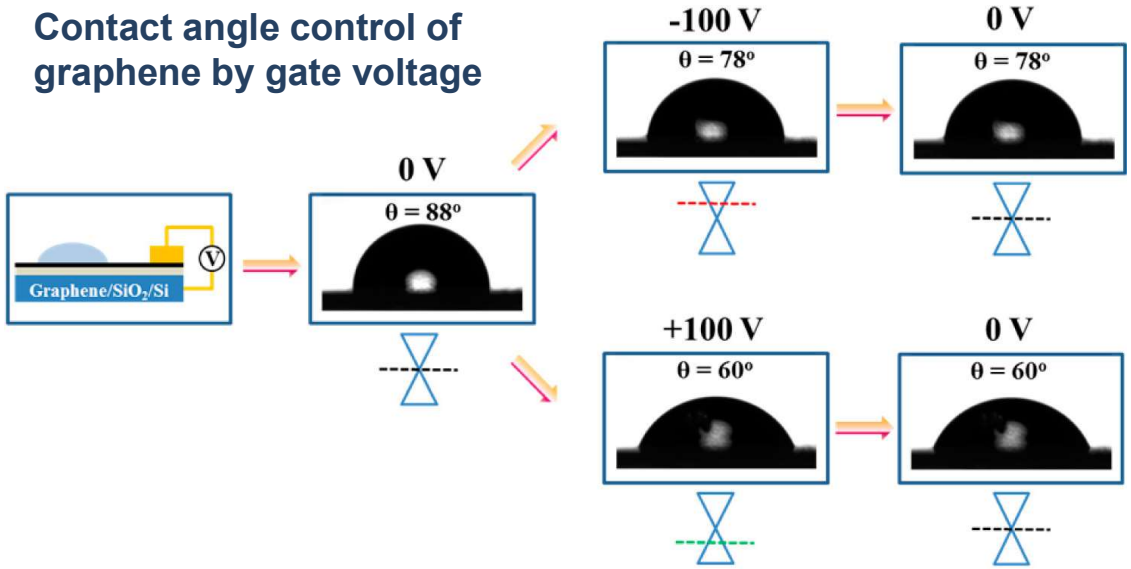
- Hydrophilicity of graphene can be influence and modulated by environment.

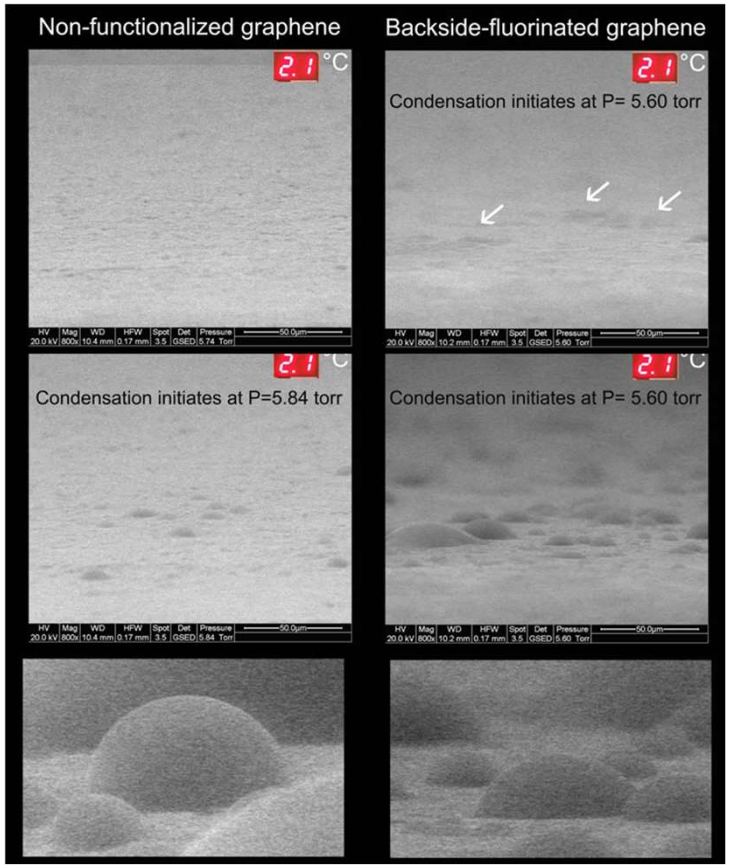
Nature Communications, 9, 1 (2018)

Surface Properties of Graphene



Contact angle control of graphene by gate voltage

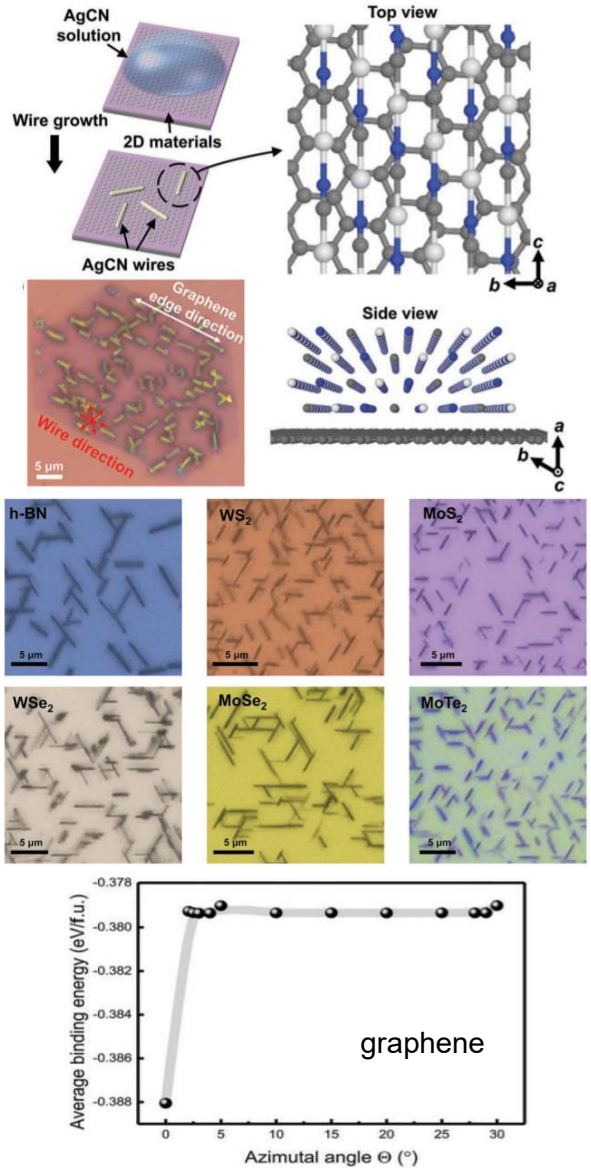




Nano Letters, 16(7), 4447–4453 (2016)

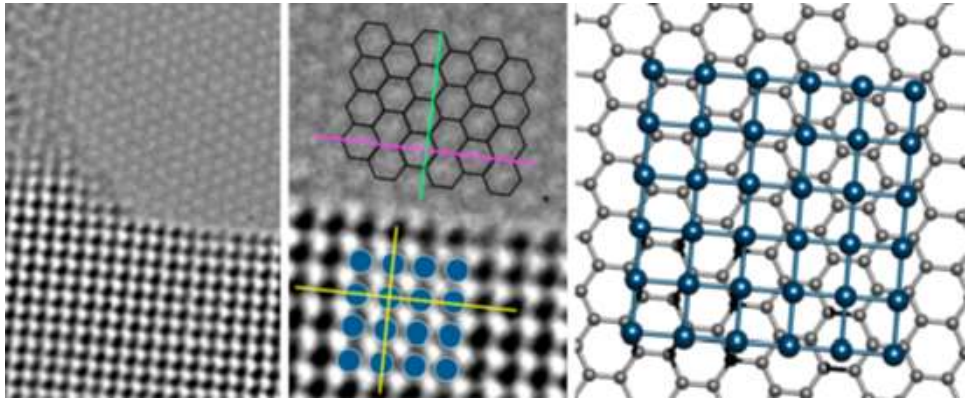
Metals on Graphene

Cyanide on 2D hexagonal crystals



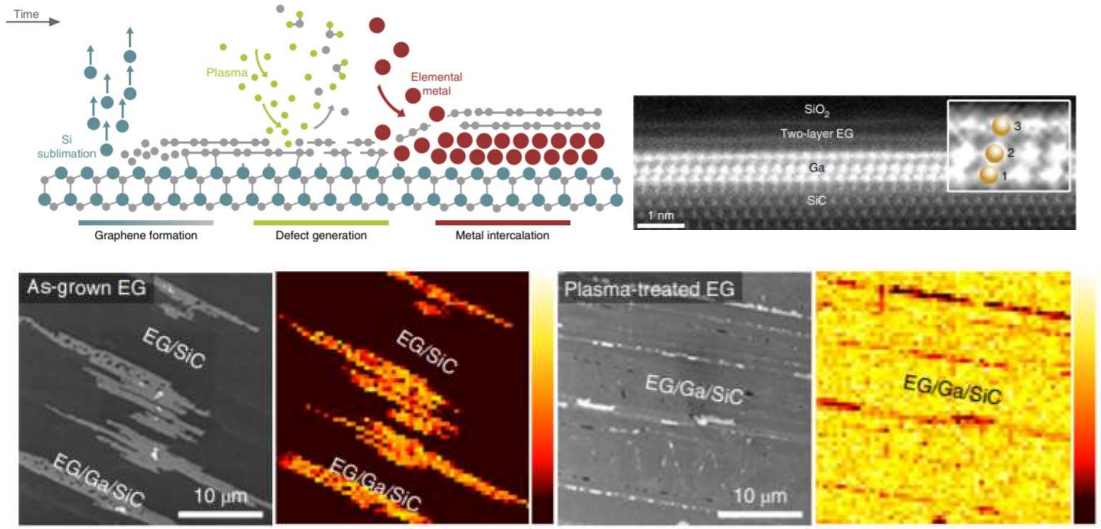
Adv. Sci. 1900757 (2019)

InGaN/GaN core–shell microrods on graphene



ACS Nano 13, 10, 12162-12170 (2019)

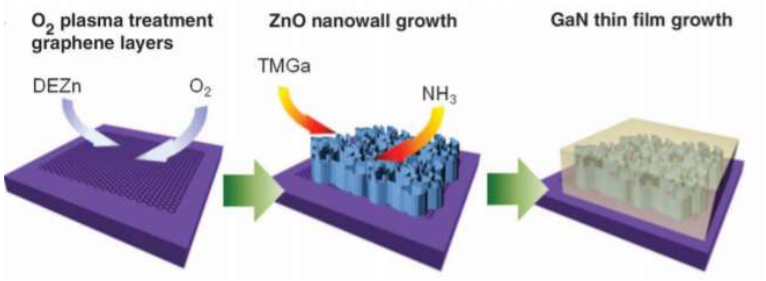
Single-crystal 2D metals at the interface of graphene and SiC



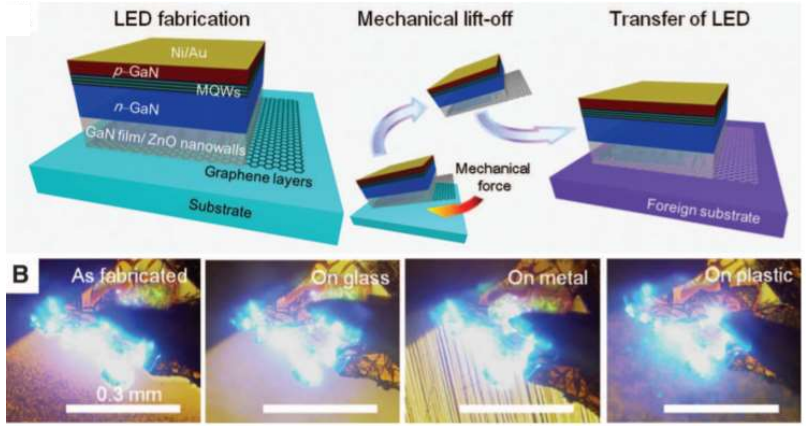
N. Briggs et al. Nature Materials (2020)

Inorganic material growth on Graphene

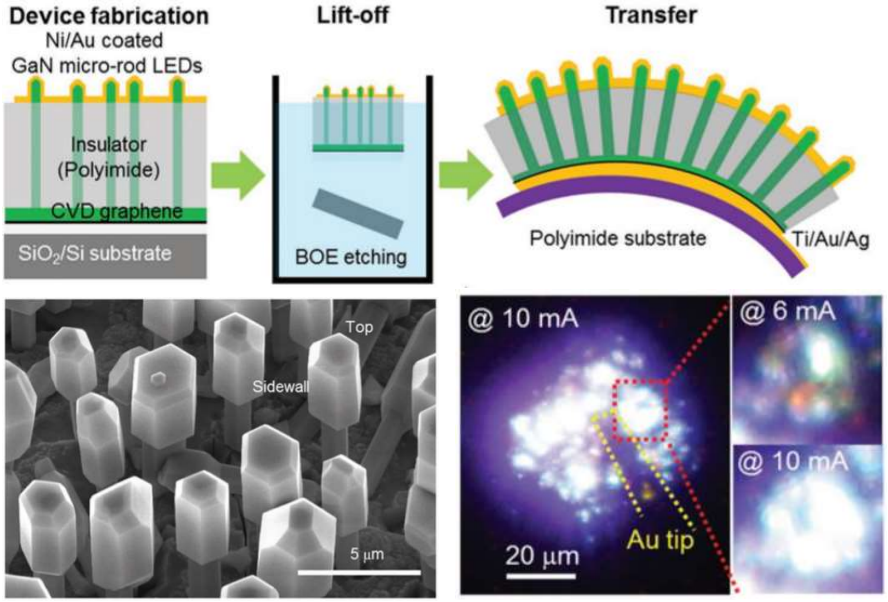
GaN on ZnO-coated Graphene



Science, 330, 6004, 655–657 (2010)

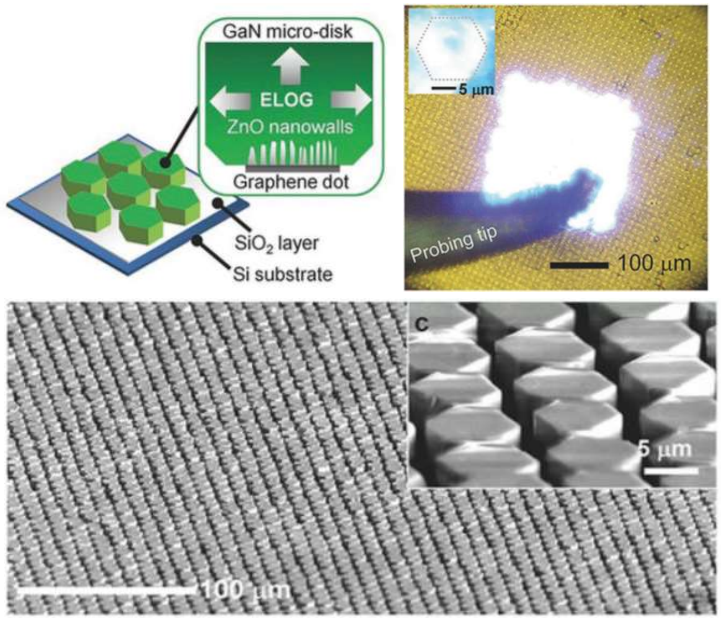


InGaN/GaN core–shell microrods on graphene



APL Mater. 2, 092512 (2014)

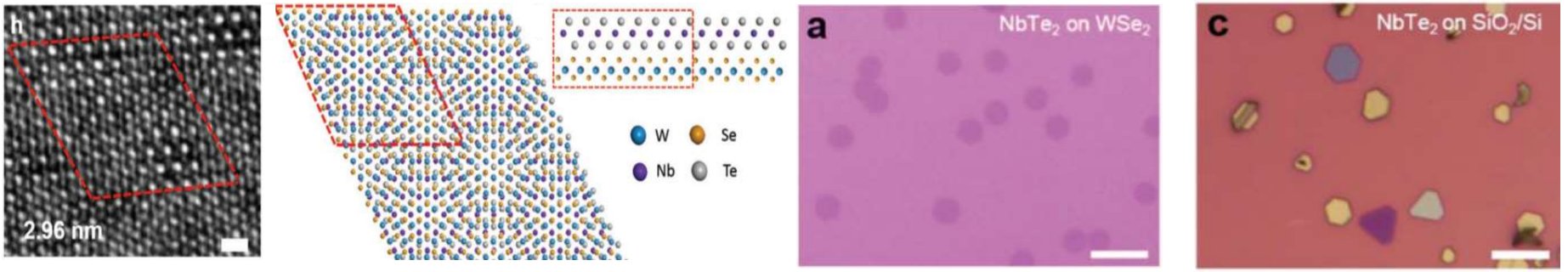
GaN microdisk arrays on ZnO/graphene dots



Adv. Mater. 28, 7688 (2016)

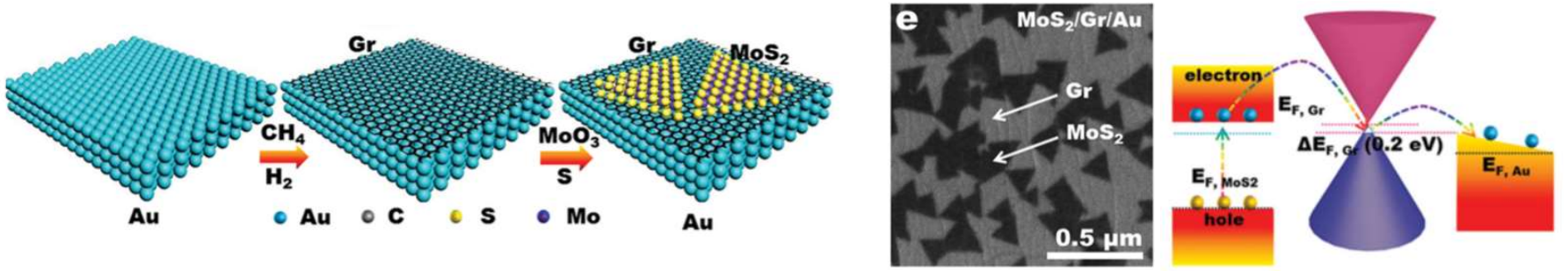
Growth of 2D material on 2D material

2D metal on WSe_2 (WS_2)



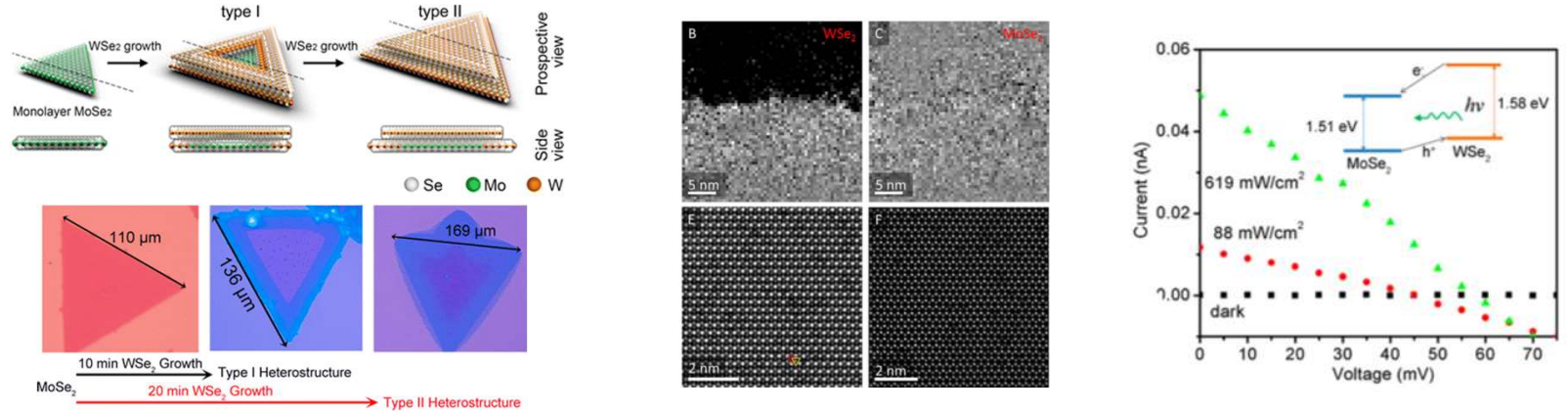
Adv. Funct. Mater. 1806611 (2019)

MoS_2 on graphene



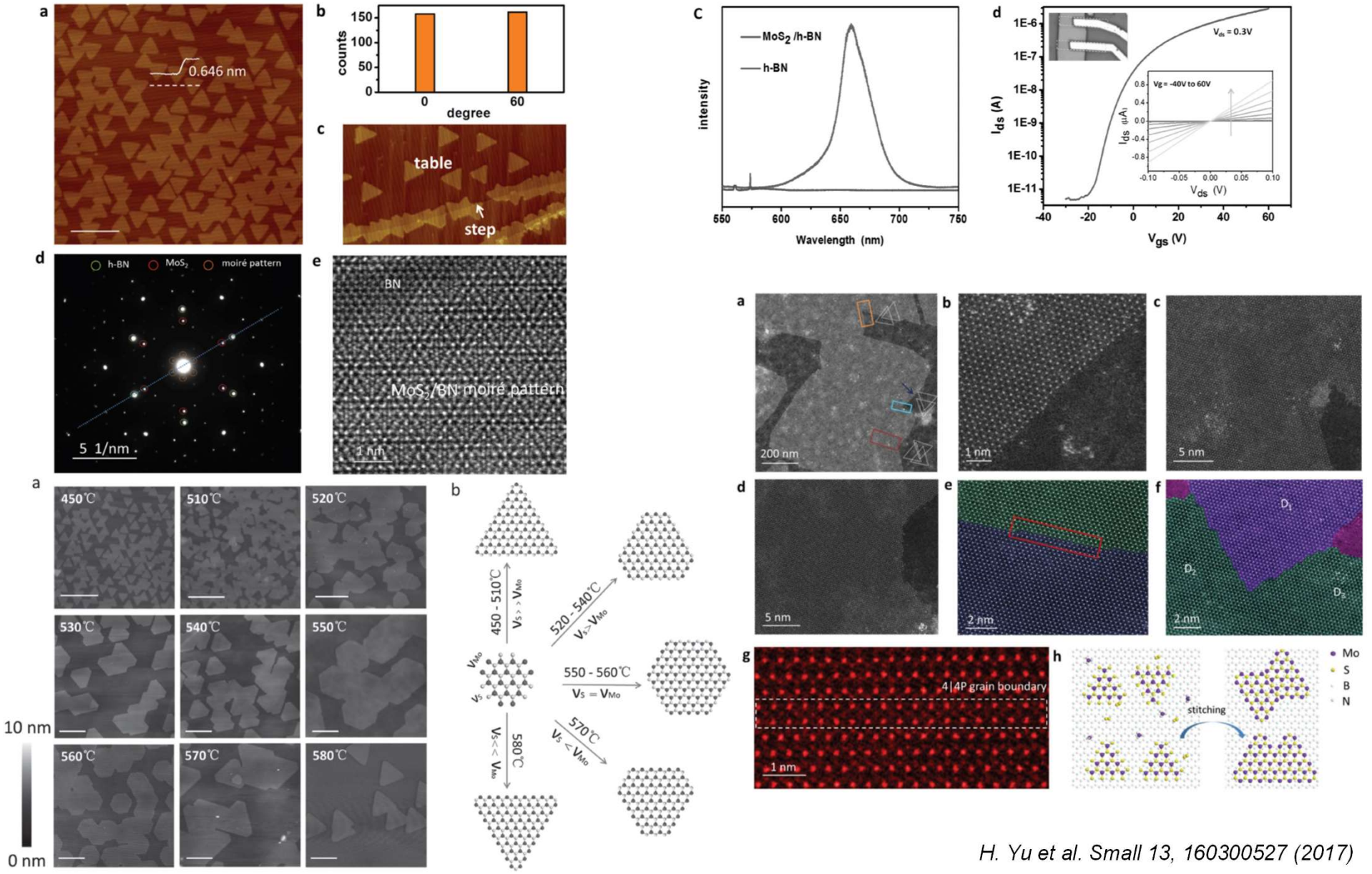
Adv. Mater. 27, 7086–7092 (2015)

WSe_2 (WS_2) on $MoSe_2$



Growth of 2D material on 2D material

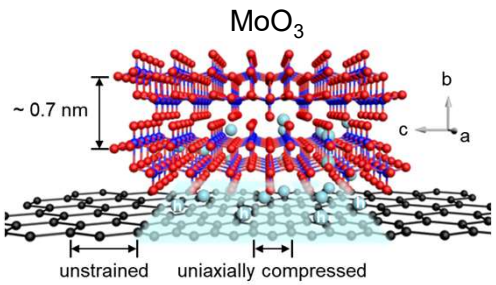
MoS_2 on hBN

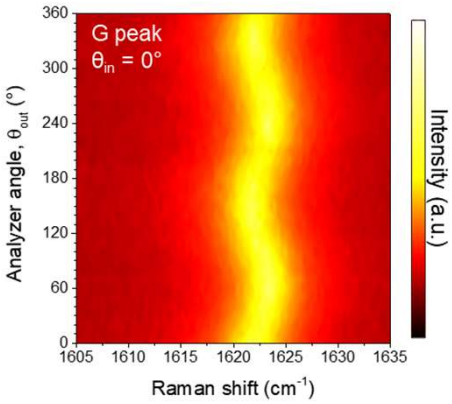


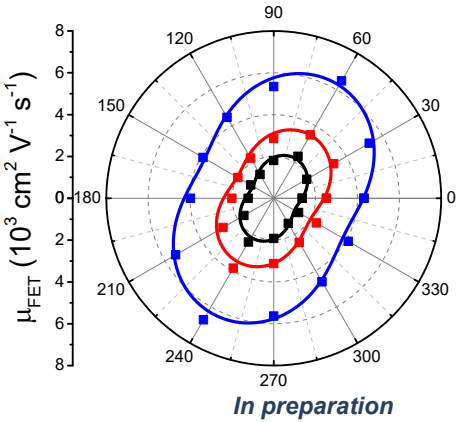
H. Yu et al. Small 13, 160300527 (2017)

Growth of 2D material on 2D material

van der Waals epitaxy and conductivity anisotropy of graphene



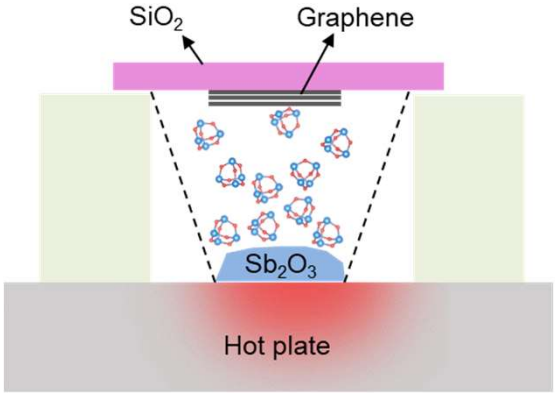


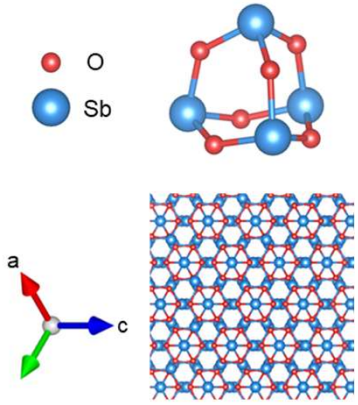


In preparation

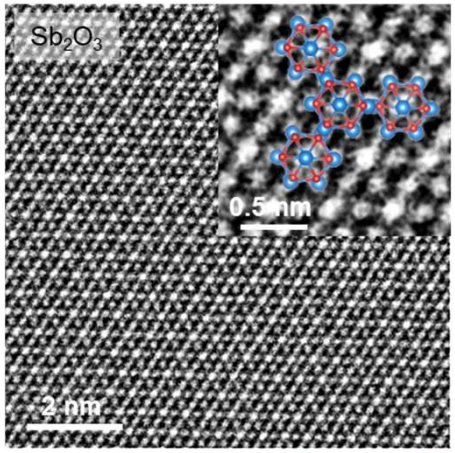
H.G. Kim et al. Science Advances (2023)

Epitaxial growth of high-k dielectric on graphene





In progress

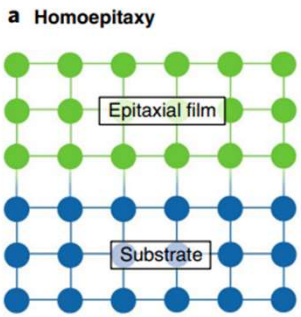


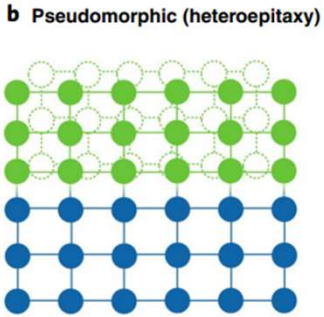
k_{Sb2O3} ~ 12.5

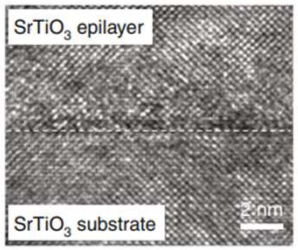
H.J. Ryu et al. in preparation

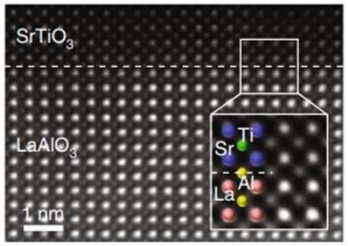
Advantages of van der Waals Epitaxy

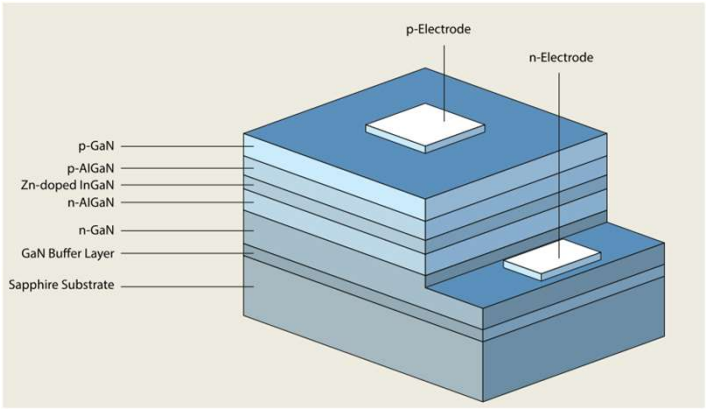
Conventional epitaxy





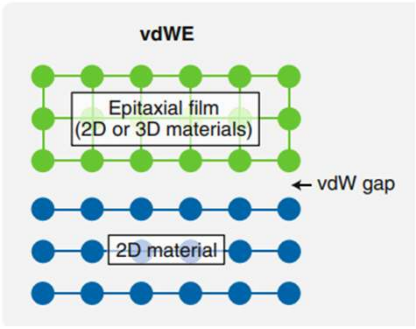


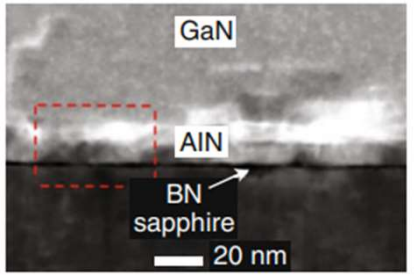




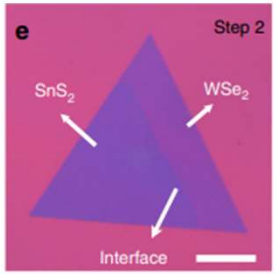
Nobel Prizes, 2014

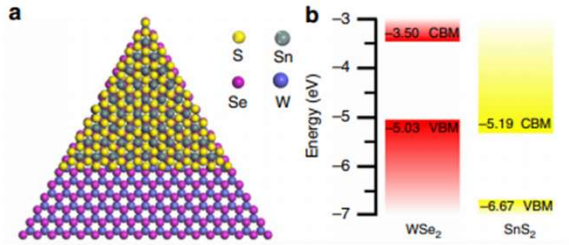
Van der Waals epitaxy



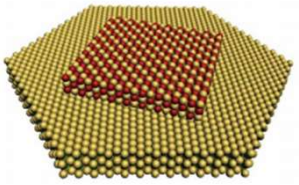


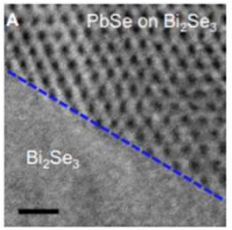
Nature Electronics, 2, 2019

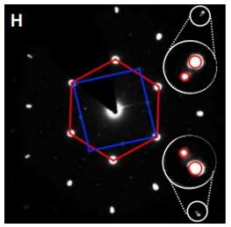




Nature Comm. 2017





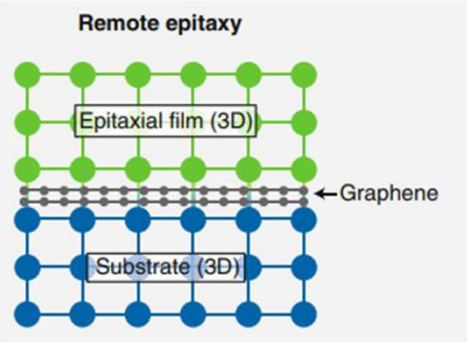


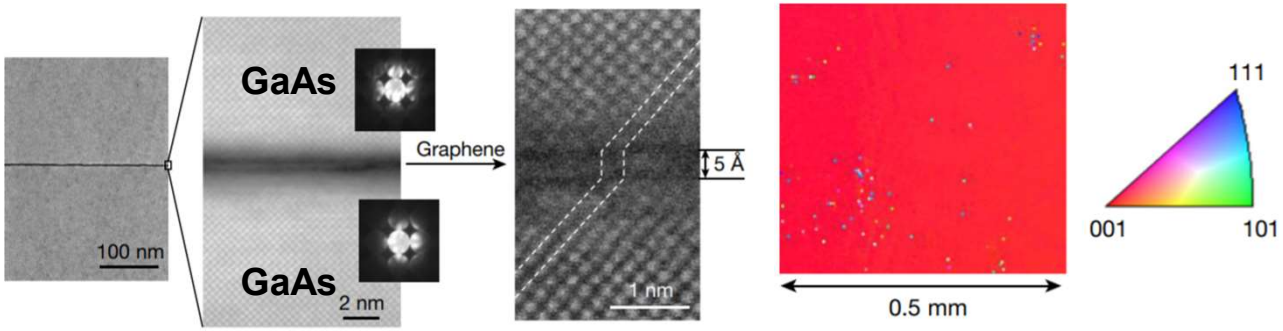
Sci. Adv. (2016)

- ❑ Interface with weak van der Waals interaction
- ❑ Higher tolerance in lattice mismatch (~40%)
- ❑ Symmetry-mismatch growth

Remote Epitaxial Growth

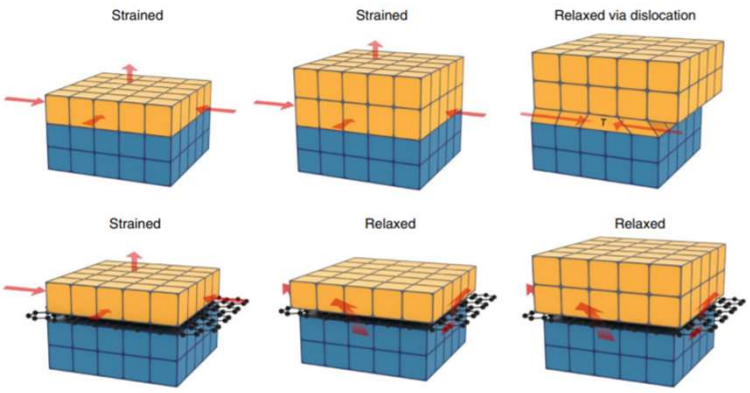
GaAs(001) on graphene/GaAs(001)

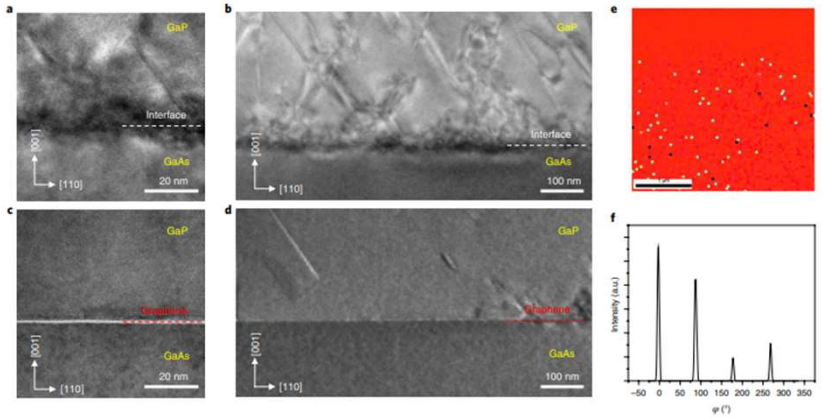




Nature (2017)

InGaP on graphene/GaAs





Nature Nanotechnology (2020)

- ❑ Epitaxial growth through transparent graphene
- ❑ Strain relaxation by slippery interface without dislocation