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Spatial modulation of graphene's chemical potential

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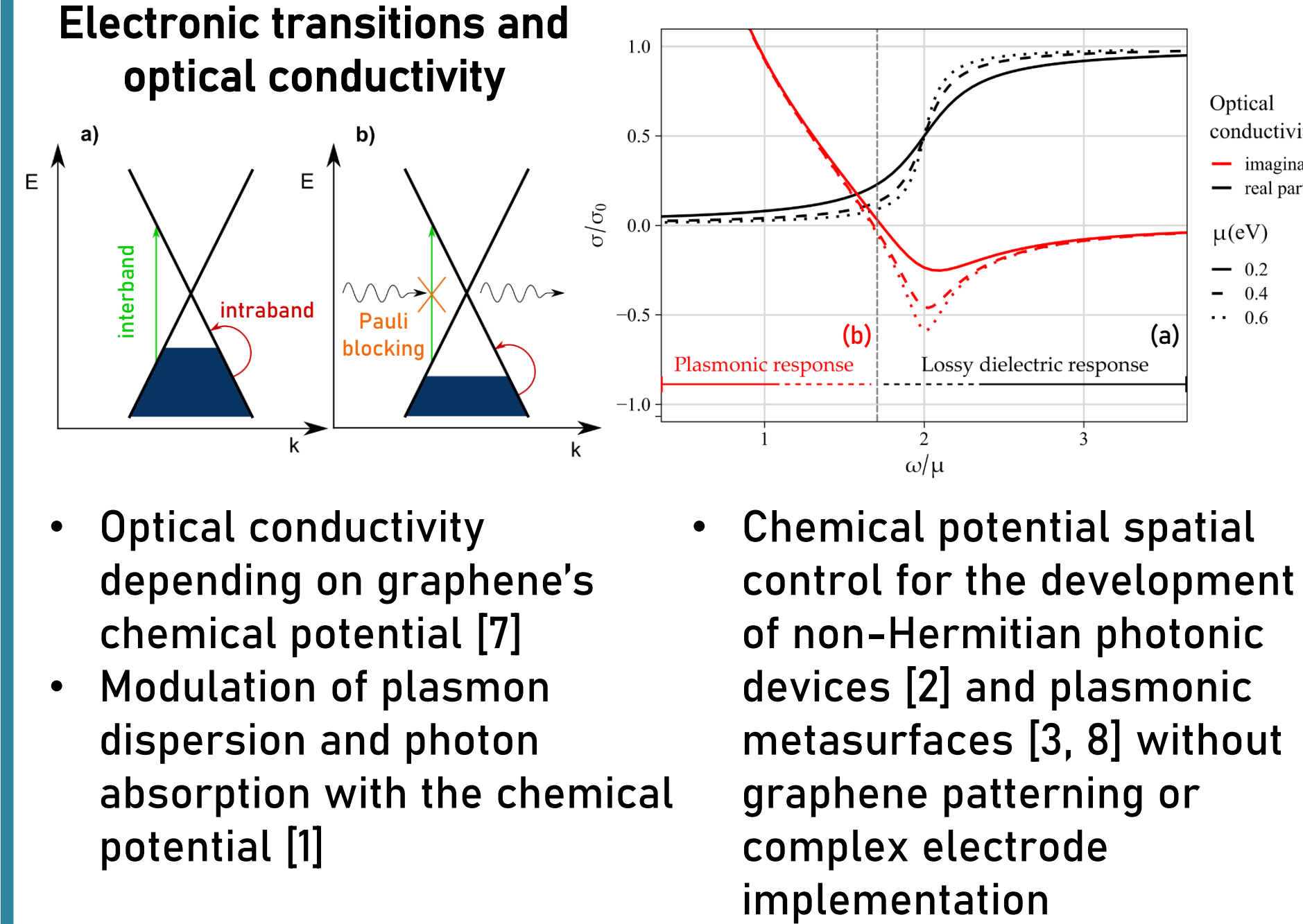
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ABSTRACT

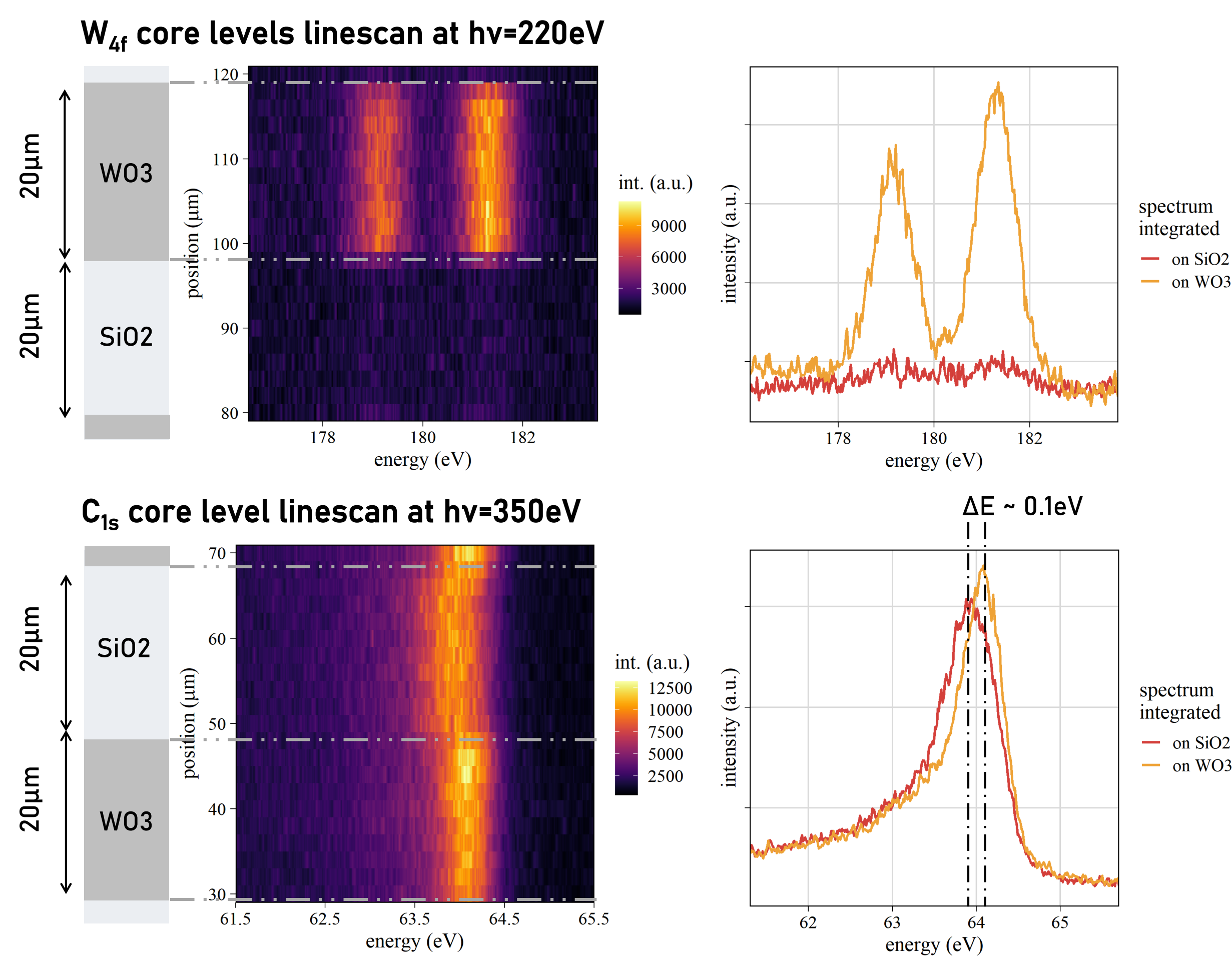
Controlling graphene's chemical potential is significant for photonic and plasmonic applications since this provides a way to modulate its optical properties at the core of tunable/reconfigurable devices [1]. In addition, chemical potential spatial control would allow us to engineer doping profile areas in graphene thus enabling the development of novel components without patterning the graphene sheet nor implementing complex matrices of electrodes [2, 3]. We here propose and characterize a structure to achieve spatial modulation of graphene's chemical potential by using charge transfer between graphene and transition metal oxide [4, 5]. Graphene is transferred onto a structure, which consists of a patterned 10nm-thick layer of tungsten oxide (WO₃) deposited onto 90nm-thick silica layer on a silicon substrate. Depending on the supporting material, namely silica or tungsten oxide, graphene is expected to have a different chemical potential. Nano-XPS scans indeed suggest a chemical potential shift of 0.1eV between graphene areas in contact with either silica or tungsten oxide, which is further confirmed by Raman spectroscopy cartography. This approach paves the way towards an easy implementation of spatial doping modulation in graphene without patterning or chemical modification of graphene.

CONTEXT

Electronic transitions and optical conductivity



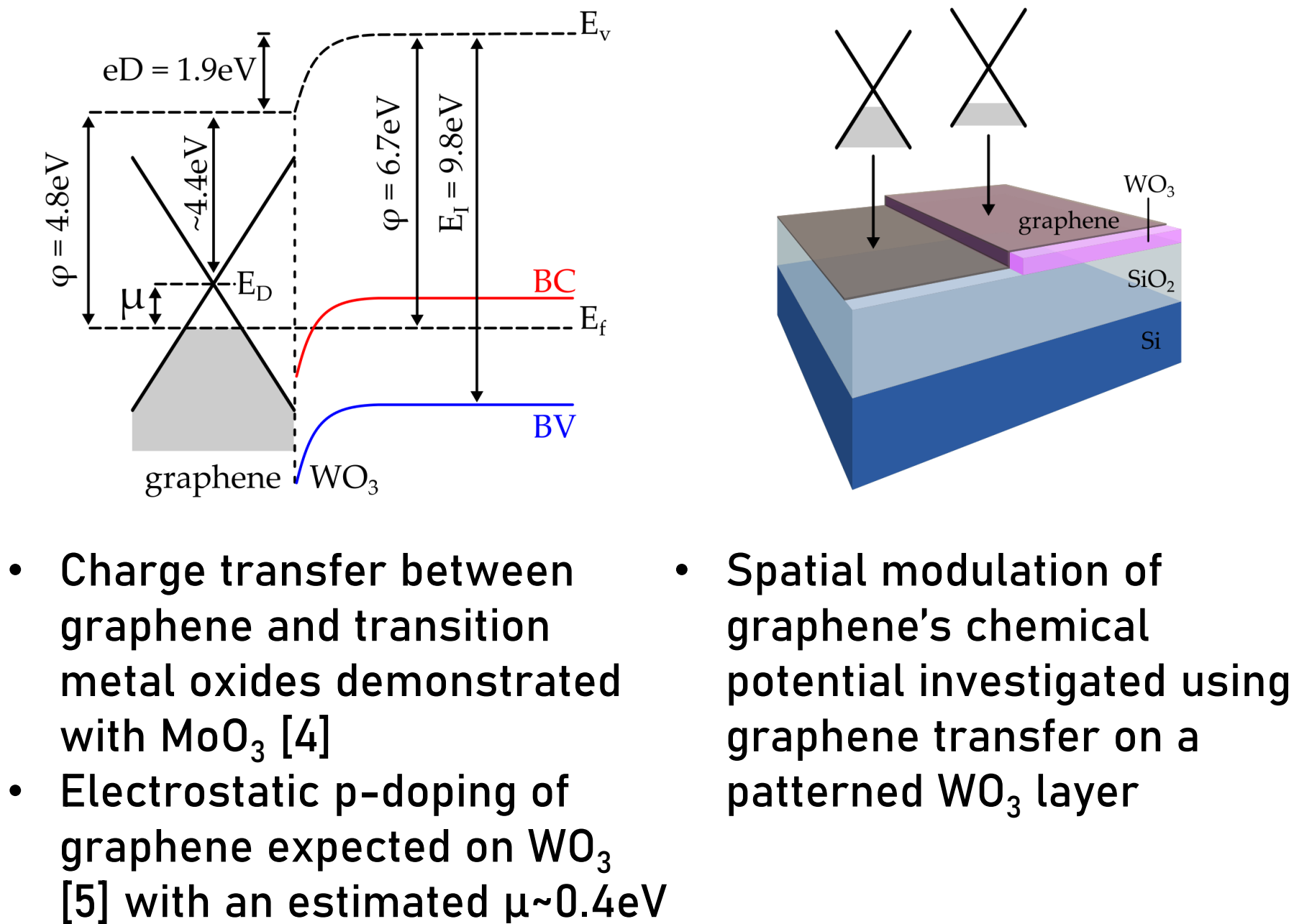
NANO-XPS MEASUREMENTS



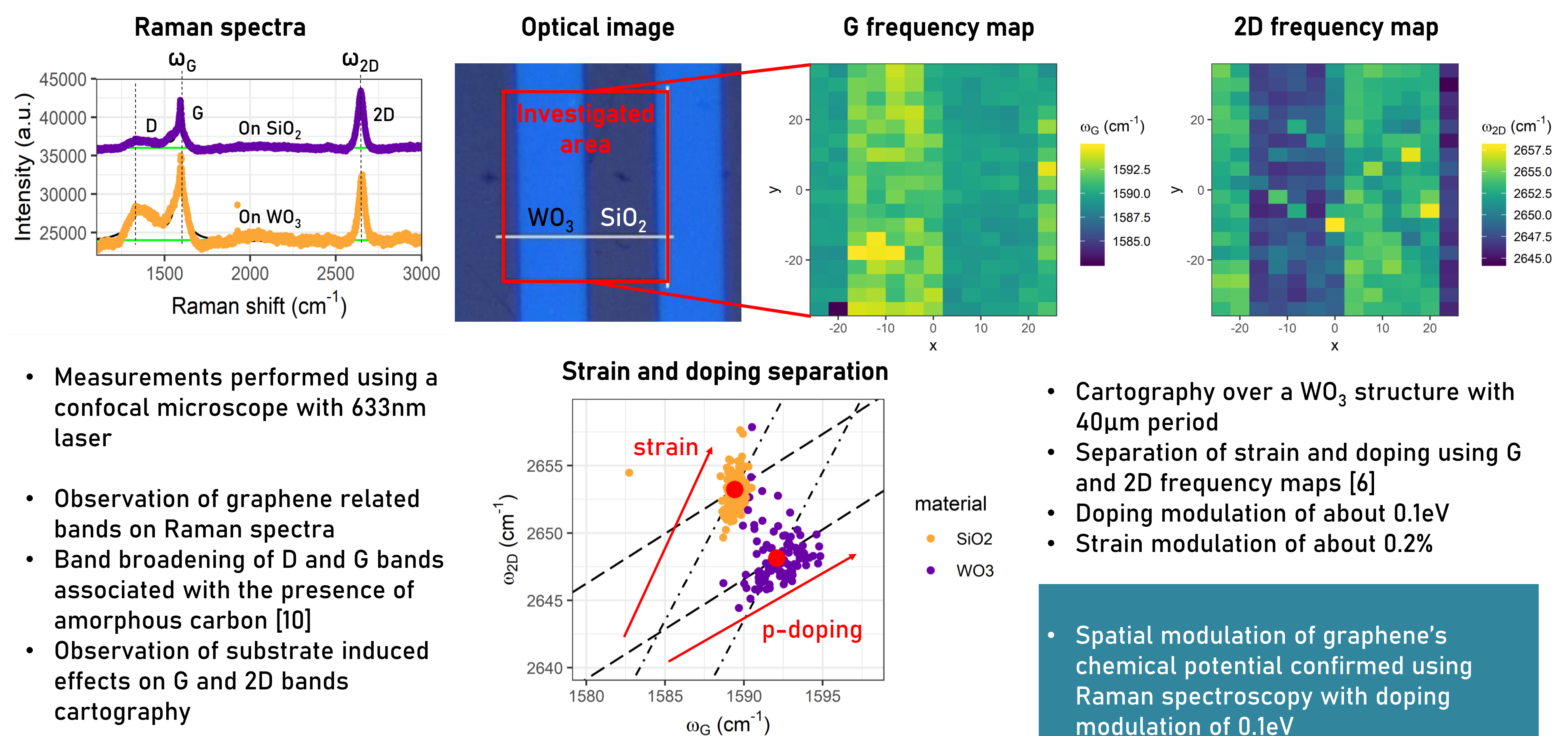
CHARGE TRANSFER WITH WO₃

Energy levels alignment between graphene and WO₃

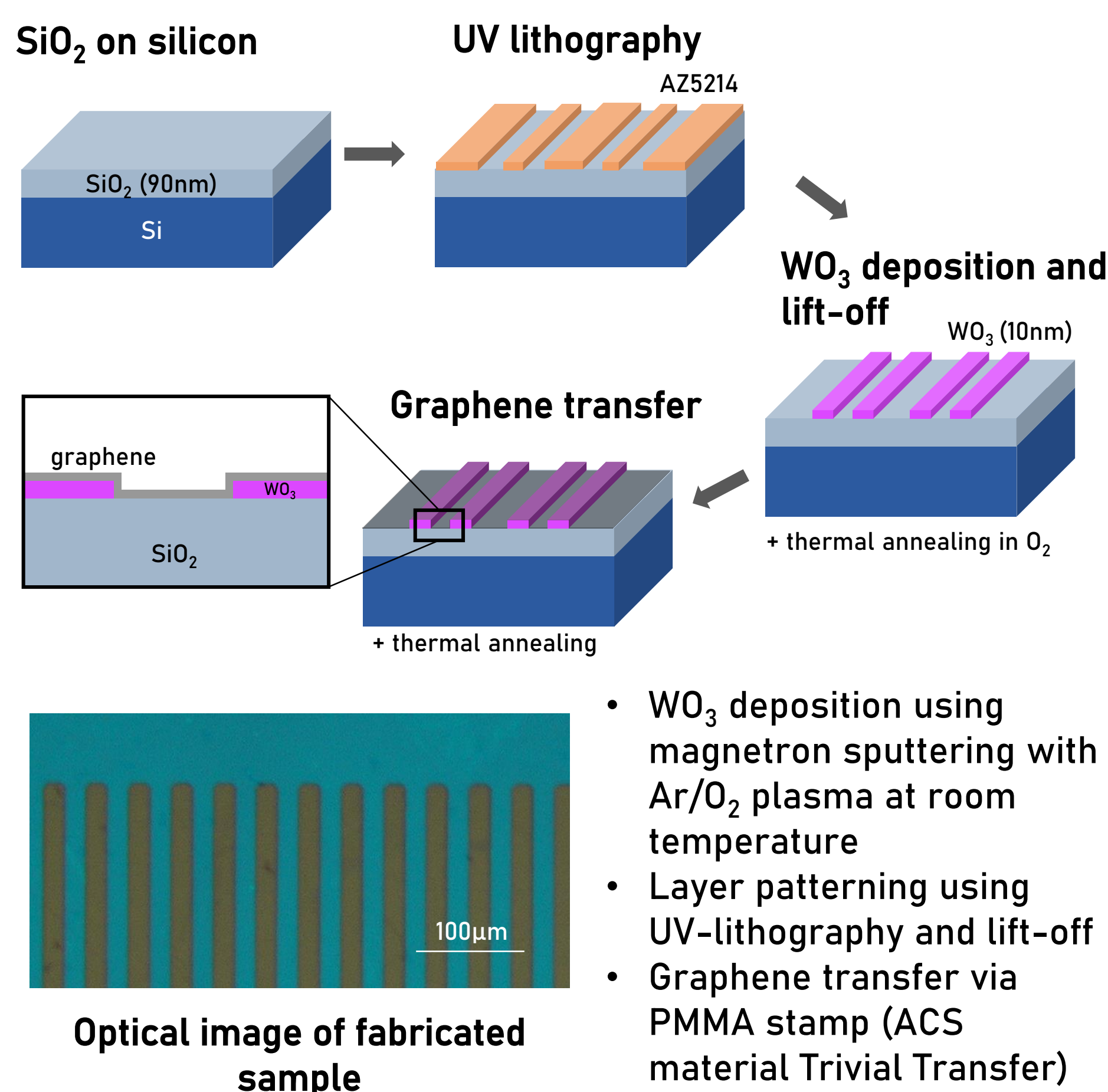
Graphene transfer on patterned WO₃ layer



RAMAN SPECTROSCOPY



FABRICATION



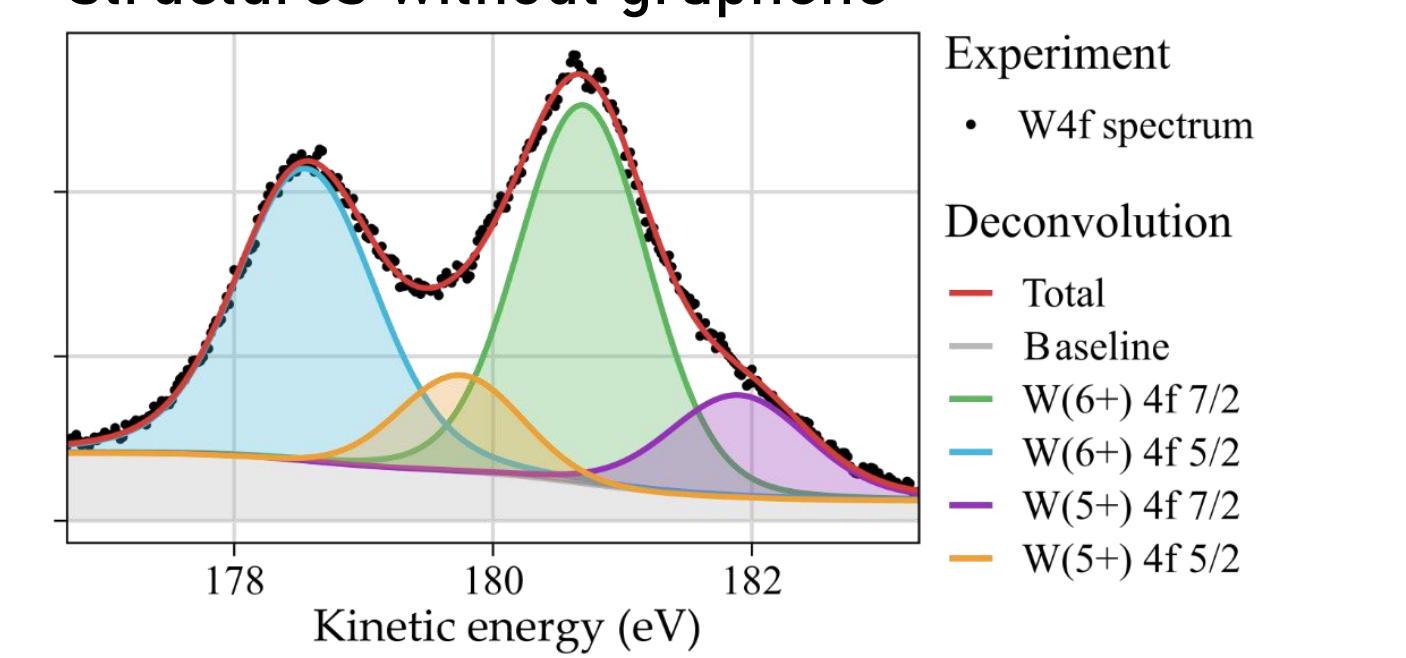
CONCLUSION

- Demonstration of charge transfer between graphene and WO₃
- Demonstration of graphene's chemical potential spatial modulation using WO₃ patterns on SiO₂
- Doping modulation of 0.1eV obtained using simple fabrication process
- Template readily available for developing novel plasmonic and mid-IR devices

PERSPECTIVES

- Evidence of oxygen vacancies in WO₃ [11] attributed to thermal annealing in vacuum
- Room for improvement of charge transfer figures
- Application of the method with other oxides

Nano-XPS W_{4f} core levels measured on WO₃ structures without graphene



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