Using graphene as epitaxial substrate and transparent electrode for AlGaN UV LEDs

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We have recently developed a generic atomic model, which describes the epitaxial growth of semiconductor nanostructures on graphene that is applicable to all conventional semiconductor materials [1, 2]. Recently we have also shown the vertical growth of dislocation-free GaN nanowires on graphene mediated by nanometer-sized AlGaN nucleation islands [3]. The epitaxial growth of semiconductor nanostructures on graphene is very appealing for device applications since graphene can function not only as a replacement of the semiconductor substrate but in addition as a transparent and flexible electrode for e.g. solar cells and LEDs.

For deep UV AlGaN based LEDs, in huge need for various disinfection and sterilization purposes, the concept offers a real advantage over present thin film based technology. Such thin film UV LEDs are today very expensive and inefficient due to the lack of a good transparent electrode, the high dislocation density in the active thin film layers, low light extraction efficiency, and the use of very expensive semiconductor substrates (e.g. AlN). NTNU and CrayoNano are now developing UV LEDs based on AlGaN nanostructures on graphene, which potentially can overcome all these problems. A proof-of principle flip-chip UV LED, will be presented at the meeting.

References

[1] A.M. Munshi, et al., Nano Letters **12**, 4570 (2012).

[2] A.M. Munshi and H. Weman, Phys. Status Solidi RRL **7**, 713 (2013). (Review)

[3] M. Heilmann et al., Nano Letters **16**, 3524 (2016).

Figures

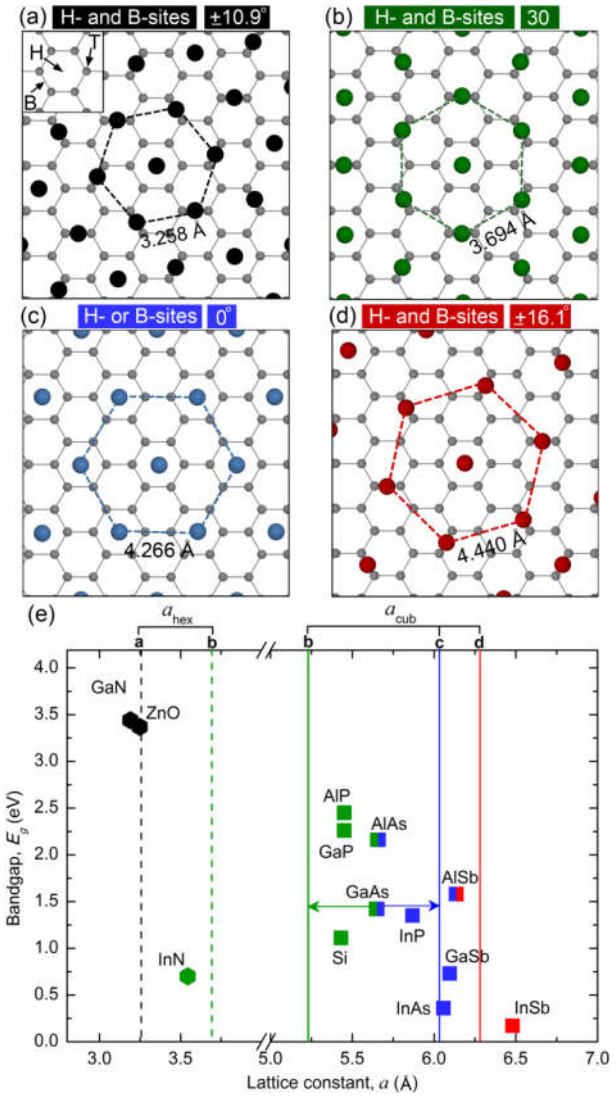

Figure 1: (a-d) Relative orientation and arrangement when semiconductor atoms are adsorbed on H- and/or B-sites. (e) Generic model describing the semiconductor bandgaps vs. lattice constants together with lattice constants for the lattice-matched atom arrangements on graphene [1].