Insights by Combined Electrical and Optical Characterization of Large Area Graphene

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Abstract

The development and manufacturing of Graphene is becoming more and more complex since research is not only focusing on the growth and transfer of graphene only. More and more R&D activities focus on doping performance, doping stability and stacking and patching strategies to achieve desired characteristics. This results in a significant better graphene, which provides the required outstanding electrical and optical [1] performance at the same time but does also require a more complex manufacturing process, which contains more steps that all need to be high quality to achieve a perfect results. In return the yield for high performance graphene is becoming smaller as the combination of process risk results in a smaller yield.

Traditional measurement concepts of layer thickness, sheet resistance and layer uniformity are difficult to apply to graphene production processes and are often harmful to the product layer [2]. New non-contact sensor concepts are required to adapt to the challenges and even the foreseeable inline production of large area graphene.

The presentation reveals the latest results achieved with a novel non-contact hybrid sensor concept which allows the characterization of electrical and optical properties of thin film materials at the same spot at the same time. The electrical characteristics such as sheet resistance are investigated by non-contact eddy current measurements, while optical properties such as the transmittance, reflectance and haze will be determined by combination of high performance light sources and customized spectrometers.

The measured electrical and optical parameters allow the classification of effects and defects and to derive further information on the Graphene quality and the cause of detected defects. Examples of doped, defected and excellent Graphene are presented as quality images (cf. figure 2) and implications for manufacturers are explained [3].

References

[1] S. Bae et al., Nature Nanotechnology, 5 (2010) 574–578
[2] J. Lama et al. Proceedings Nanotech Dubai (2015)
[3] M. Klein et al. Proceedings GraphChina, Nanjing (2017)

Figures

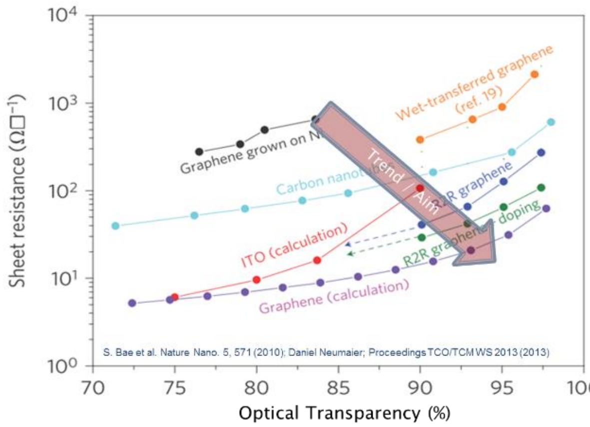

Figure 1: Achievable sheet resistance to optical transparency performance of Graphene and ITO

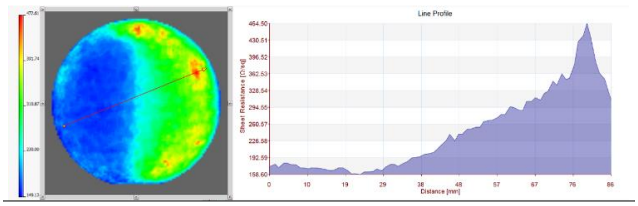

Figure 2: 4 inch Graphene with strong doping profile