Wafer scale engineering of microstructured graphene oxide and a new reduction method via RTP processing

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Abstract:
There is still a plenty room to the bottom to find the ideal, controllable and fast reduction method to transform graphene oxide (GO) into reduced GO (rGO). In this contribution we present the effective combination of the thermal reduction with H_2 by using rapid thermal processing (RTP).
The synthesis [1] of graphite 325mesh and graphenium crystals to the insulating material GO, which can be spin-coated as a thin film of 1-2 nm thickness over 4-inch wafers, is well established in our group.
Before micro structuring and metallization can take place the optimal reduction parameters for GO on Si/SiO_2 must be found to make use of GO as a highly sensitive transducer layer for electrical sensing [2]. Therefore different temperatures between 300°C to 1000°C were tried out.
By increasing the temperature the containing oxygen groups disappeared from GO surface under sp^2 bond formation. In addition the hydrophilicity of the GO layer increases and the electrical resistance decreases, simultaneously. I/V-dual sweeps determined a lowest achievable sheet resistance in our interdigitated microelectrode (IDE) designs in the range of 300-400 kΩ after reaching 600°C, which was expected by previous XPS-measurements. Raman mapping of rGO showed also homogeneous layer intensity.

Figures

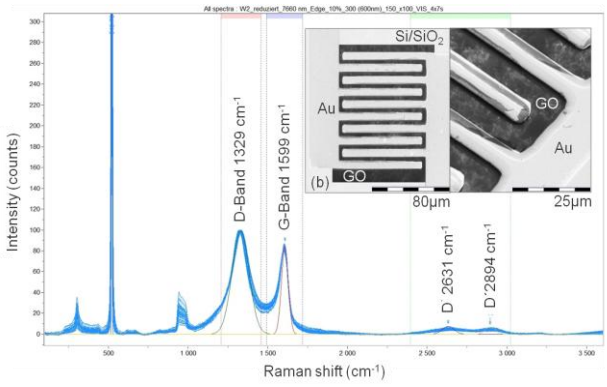

Figure 1: (a) Raman mapping (10x10 spots) of the rGO transducer layer at IDE electrode structures.

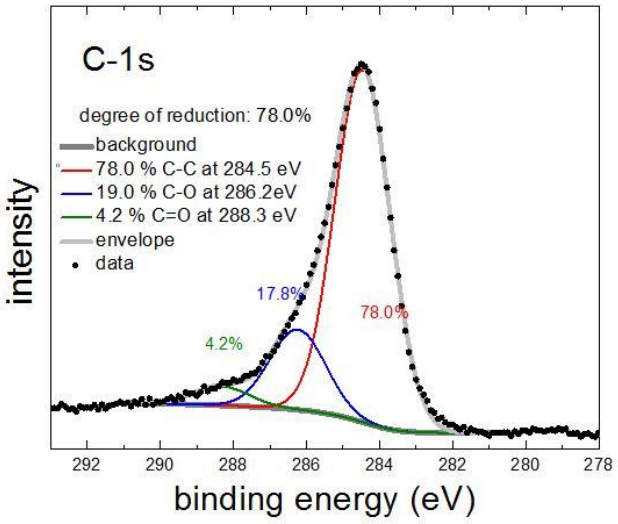

Figure 2: XPS analyses after H_2 reduction

Among all common reduction methods, the RTP technique is the most precise one to reduce a GO transducer layer in a controllable manner.

References

[1] D. C. Marcano, D. V. Kosynkin et al., ACS Nano, VOL. 4, NO. 8 (2010) 4806
[2] Warner, F. Schäffel. A. Bachmatiuk. Graphene. Fundamentals and emergent applications. Oxford 2013 S.388f