

Functionalized Processable Graphene from Electrochemical Approaches

Dr. Martin R. Lohe

Sheng Yang, Ali Shaygan Nia, Xinliang Feng

Center for Advancing Electronics Dresden (cfaed) & Department of Chemistry and Food Chemistry, Technische Universität Dresden, 01062 Dresden, Germany

martin.lohe@tu-dresden.de

The rapid rise of 2D materials over the past decade evidences not only a basic scientific interest but also their potential technological impact, as they might play a ground-breaking role in future electronics, printed circuits and sensors, wearable applications, composites and the storage and utilization of clean electric power obtained from renewable resources.

For graphene however, there has been a gap between laboratory-scale research and commercial applications for a long time due to the lack of reproducible bulk production methods at low cost level. Today many of these challenges seem solved, with production capacities reaching ton scale for both graphene and graphene oxide materials and the first products established on the market. However, there are still challenges, especially when it comes to processing. Liquid phase exfoliation techniques for instance, can provide high quality products with low defects, but the sheets are small and need surfactants or other additives to avoid restacking, which are difficult to remove and can reduce matrix-interactions and final conductivity. In contrast, graphene oxide lacks electrical conductivity and the outstanding mechanical properties of graphene, but can be dried and redispersed and therefore shows significant advantages in terms of processability. Due to its high density of

functional groups GO can also be easily functionalized for different purposes.

The electrochemical preparation of graphene combines the best of both worlds. With our recent advances in the simultaneous electrochemical production and functionalization, we are able to provide a new generation of processable, yet high quality few-layer graphenes. Depending on the process conditions, a tuneable level of defects and defined functional groups can be introduced, that improve processability while maintaining a good electrical conductivity and reasonable sheet size.

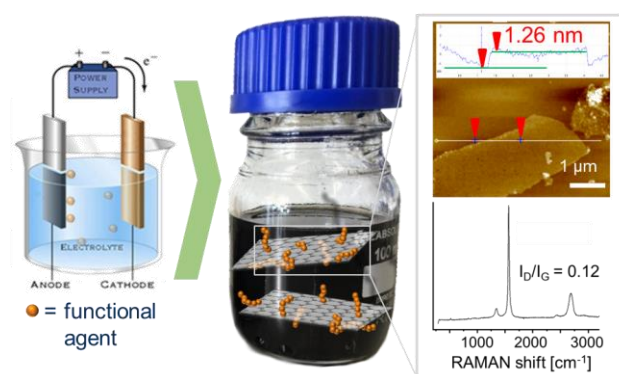


Figure 1: Surfactant-free aqueous dispersion of high quality functionalized few-layer graphene.

Combined with a scalable and eco-friendly process technology we are opening up new possibilities and prospects for the applications graphene, mainly in the field of inks, composites, electronics, energy storage and energy conversion.

References

- [1] Int. Patent Appl., PCT/EP2016/072153
- [2] Ger. Patent Appl. 10 2017 207 045.5
- [3] Ger. Patent Appl. 10 2017 223 892.5