Functionalized Few-Layer-Graphenes: High Quality and Outstanding Processability without Compromises

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ABSTRACT

The process of electrochemical exfoliation and functionalization of graphene, developed at TU Dresden and patented by Sixonia Tech GmbH[1] creates the ability to functionalize few-layer graphenes deliberately and precisely, directly during their production. This versatility allows us to modify graphene solutions to suit selected substrates, intermediates or end compounds. Building the knowhow to tailor the graphene-solution-substrate systems enables us to achieve desired performance goals and meet particular application process requirements. By providing good scalability and yield, low production costs and the good processability, our mission is to unleash the currently limited potential of graphene in various fields.

The scalable and eco-friendly process technology opens up new possibilities and prospects for the applications of graphene, in the field of inks, composites, sensors, energy storage and energy conversion.

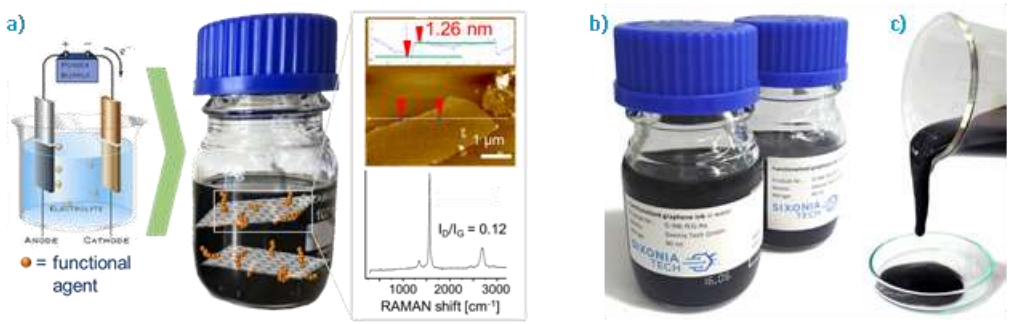

Fig. 1.: Surfactant-free aqueous dispersion of functionalized high-quality few-layer graphene (a), customizable conductive inks (b) and high viscosity formulations (c) based on our advanced E-Graphenes.

As an example, our E-Graphenes can be functionalized to be dispersible in water without the need for surfactants (Fig. 1a), while still maintaining an intrinsic conductivity that is at least one order of magnitude higher than that of commonly used reduced graphene oxide (rGO) materials. Sixonia Tech can help to identify the most suitable graphene for a given application and formulate it (Fig. 1b, c), to facilitate its integration into the desired applications.

Compared to other “graphene” products, E-Graphenes show a superior combination of tailorable properties within a single material, such as large flake-size in the µm-range, low thickness in the range of 1-10 layers and good processability. Unlike in GO, the defined functional groups can provide an improved processability while still maintaining high electrical conductivity and reasonable sheet size.

As an example, here are the specifications for our E-Graphene CSO in aqueous dispersion:

Physical Properties		**Chemical properties**	
Colour:	black	Odour:	odourless
Graphene concentration:	≥ 2 mg/ml	Solvent:	water
Additives/Binders:	none	pH:	(adjust. on demand)
Lateral Size (avg.):	1-2 µm	Zeta Potential:	-35 mV @ pH 3 to -60 mV @ pH 10
Thickness (avg.):	1-5 atomic layers		
Conductivity (bulk):	> 40 000 S/m	Raman D/G-ratio:	0.1-0.2
Resistivity (bulk):	< $2.5 \cdot 10^{-3}$ Ωcm	C/O ratio:	~20
Sheet resistance:	< 1 Ω/□ @ 25µm		

REFERENCES

[1] Sixonia Tech GmbH; Int. Pat. Appl. PCT/EP2018/085825, 2018