A universal approach for formulation of additive-free 2D material-based inks for room-temperature printing of electronics

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Abstract

We here introduce a new approach for the formulation of 2D materials into printable or coatable inks for the fabrication of functional devices [1]. In a traditional ink formulation, additives are introduced in large concentrations to address processing challenges, but they drastically degrade the electronic properties of the materials. For the removal of the additives, a high-temperature post-deposition treatment can be used, but this complicates the fabrication process and limits the choice of materials (i.e., no heatsensitive materials). The unique properties of 2D materials offer the possibility to formulate additive-free inks in which the roles of the additives are taken over by van der Waals (vdW) interactions. The approach is universal and is demonstrated with a number of 2D materials. In this new class of inks, solvents are dispersed within the interconnected network of 2D materials, increasing the possible choice of solvents over traditional inks where dispersibility-related issues limit the selection. Furthermore, flow behavior of the inks and mechanical properties of the resultant films are mainly controlled by the inter-flake vdW attractions and can be largely controlled via concentration and choice of solvent. The structure of the vdW inks, their rheological properties, and film-formation behavior are discussed in detail. A method for large-scale production of inks for all major high-throughput printing and coating is introduced.

References

[1] [1] S. Abdolhosseinzadeh, C. Zhang, R. Schneider, M. Shakoorioskooie, F. Nüesch, J. Heier, Adv.Mater.2022, 34, 2103660.

Figures

Figure 1: Aggregated graphene nanosheets are processed into a homogeneous gel that can be used for formulation of additive-free functional inks.