Bipolar electrochemistry for functionalization of 2D materials

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Abstract

After the isolation of the graphene monolayer, 2D material have garnered great attention due to their unique properties. Covalent functionalization strategies are used to further finetune and improve these properties, which allows to integrate this material into a wide range of applications. However, these strategies need either highly reactive conditions, which do not guarantee a control over the degree and homogeneity of functionalization of the surface. Electrografting is a powerful tool known to modify a wide range of material in a controlled manner, by using said material as electrodes. Nevertheless, this method does not allow the functionalization of non-conductive surfaces and not much work has been done on 2D materials besides graphene. Recently, bipolar electrochemistry, a low cost, efficient and facile technique has been used to functionalize graphene material without the need to connect to a potentiostat. By applying a high voltage to the electrolyte cell, a gradient of the electric field occurs over the cell which induces the polarization of material placed between two electrodes. The polarization drives simultaneous reduction and oxidation reactions at the opposite poles of the placed material. This opens possibilities of functionalization of inert and semiconductor material, which opens new material with new properties. Furthermore, to achieve scalable production of modified 2D materials suitable for the high throughput needed for industrial application development of new production techniques are necessary. Bipolar electrochemistry has proven to be a promising method for the exfoliation from bulk to monolayer material. A wide range of material has been proven to be obtainable by such a method. The objective of this work is to then combine both exfoliation and functionalization in a one-pot method for the scalable production of new material with modified properties for facile production of 2D material in dispersion. The material is then characterized by techniques such as Raman and AFM.

References

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