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Functionalization and Reduction of Graphene Oxide

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Abstract

© 2017 John Wiley & Sons, Ltd.The chemistry of graphene oxide (GO) is a growing field of research. The modification of the surface properties of GO is the main goal in application-driven research. Successful functionalization protocols must be interpreted in accordance with the chemical structure of the original GO, and therefore, in this chapter, crucial aspects of the chemical structure of GO are introduced first. Next, the thermal and chemical stability of GO is reviewed, followed by introducing wet-chemical non-covalent and covalent reaction principles. The covalent functionalization of GO requires special attention. When chemical reaction principles, well known from organic chemistry, are applied to GO, it remains challenging to prove the successful accomplishment of reactions by analyzing the as-modified GO product. We pay special attention to the reactivity of the edges of defects and provide alternative explanations for interpreting experimental results, where necessary. Next, chemical reduction methods are summarized; special accent is placed on differentiating true chemical reduction from so-called "thermal reduction". Several examples for the functionalization of reduced graphene oxide (RGO) are considered next. While discussing GO chemical properties, in parallel with typical GO, we discuss these properties for the oxo-functionalized graphene (oxo-G1), a type of GO with very low density of structural defects. This sheds additional light on the role of defects in GO chemistry. Finally, additional properties of oxo-G1 are introduced. Oxo-G1 can act as a compound that enables the controlled chemistry for the design and synthesis of functional materials and devices.

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Keywords

Functionalization, Graphene, Graphene oxide, Reduced graphene oxide, Reduction