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Chemistry of Fluorographene, From Understanding to Applications

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Fluorographene (FG) is a stoichiometric graphene derivative with C_1F_1 composition. It can be prepared by delamination of graphite fluoride, which is an industrially available material. As a perfluorinated hydrocarbon, fluorographene was considered unreactive, but in reality, it undergoes various chemical reactions at rather mild conditions [1]. Fluorographene and fluorinated graphenes (CF_x) are susceptible for reductive defluorination, nucleophilic attack, Grignard [2], Bingel-Hirsch [3], photo Diels-Alder [4] and Sonogashira [5] reactions. The reactions result in homogeneously and densely functionalized graphenes. These findings make fluorographene a well-suited material for large scale synthesis of a wide spectrum of graphene derivatives. Such materials can be utilized in a broad spectrum of applications. Due to high-conductivity and water dispersibility some of them can be used as electrode materials for supercapacitors [3, 6]. Various hydroxyfluorographenes can bear room-temperature antiferromagnetic or ferromagnetic ordering based on their composition [7]. Cyanographene, and graphene acid [8] are well biocompatible materials suitable for further functionalization. Conjugating these materials with redox active centers, e.g., ferrocene, can lead to heterogenous catalysts [9]. Anchoring metal ions to cyanographene resulted in a single-atom catalyst very active in oxidative amine coupling reactions [10].

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