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Microorganism mediated synthesis of reduced graphene oxide films

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Abstract. The wide-ranging industrial application of graphene and related compounds has led researchers to devise methods for the synthesis of high quality graphene. We recently reported on the chemical synthesis, patterning, and doping of graphene films by the chemical exfoliation of graphite into graphene oxide (GO) with subsequent chemical reduction into graphene films [1, 2]. Here, we describe a hybrid approach for the synthesis of reduced graphene sheets, where chemically derived GO was reduced by microorganisms extracted from a riverside near the University. Our procedure enabled the production of ~100 μm sized reduced graphene sheets, which showed excellent Raman spectra associated with high quality reduced graphene. We give a detailed account of the relationship between the type of microorganisms and the properties of the resulting reduced graphene.

1. Introduction

Chemically-derived graphene, composed of a single layer of carbon, now has an available route for bulk production. GO seems to be a much more efficient, low-cost, and bulk production pathway to incorporate graphene sheets into hybrids [3].

Currently, the most intensely researched approach for large-scale graphene production is through the chemical reduction of chemically derived GO, which can be obtained from natural graphite powder. GO may be reduced to graphene, either by exposure to pure hydrazine or by means of a thermal treatment. However, these methods have some drawbacks. First, hydrazine vapors are highly toxic. Second, thermal reduction is a very complex phenomenon because of the thermal-energy-induced multi-step removal processes of intercalated H_2O molecules and oxide groups of –COOH