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Carbon nanomaterials prepared from unconventional sources by iron catalyzed acid dehydration and mechanical exfoliation

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Carbon nanomaterials have a unique attention in nanoscience owing to their exceptional electrical, thermal, chemical and mechanical properties and have found different applications such as energy storage/conversion, sensors and drug delivery. Several processes have been considered for the carbon nanomaterial preparation and the major goal is to find scalable process for high yield production [1]. In this work carbon nanomaterials have been prepared by two approaches. First approach utilizes as unconventional sources powdered milk and sugar, subjected to iron catalyzed acid dehydration, followed by a hydrothermal treatment (121°C at 15 psi for 6 hrs). In a second approach, graphite flakes were subjected to liquid exfoliation with the aid of a commercial mixer and a commercial surfactant. FTIR spectra show the presence of carboxy, phenol and epoxy groups [2] as well as Fe-O related bands in samples produced from sugar and milk. Mechanically exfoliated graphene spectrum only displays some epoxy bands. Raman spectra indicate a defective structure in the carbon materials obtained from milk and sugar, although the presence of the iron catalyst in powdered milk carbon seems to improve the graphitic peak in the Raman spectra. On the other side, long term stable suspensions were achieved by surfactant assisted liquid exfoliation of graphite flakes and the corresponding Raman spectra display noticeable G and 2G band, characteristic of high quality graphene [3].

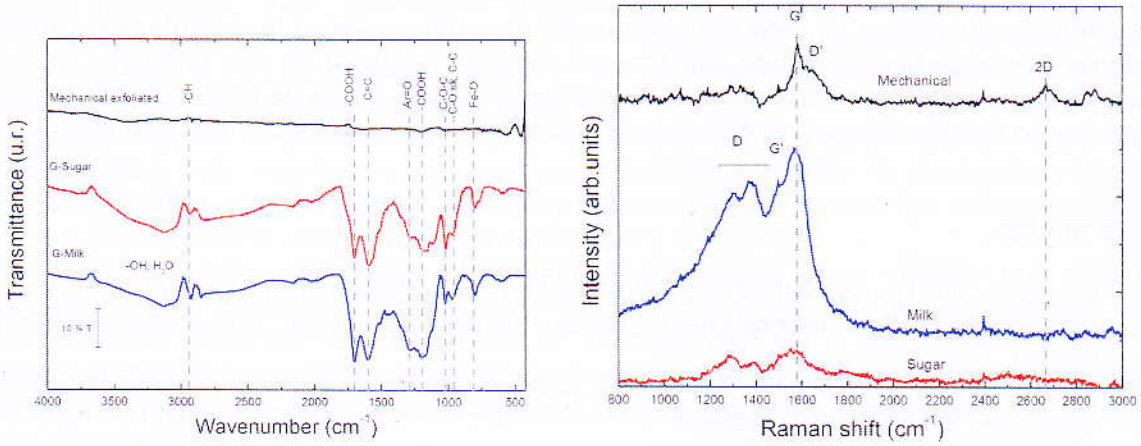

Figure 1. FTIR (left) and Raman spectra (right) of the graphene samples

TEM micrographs indicate that milk and sugar derived carbon materials are amorphous, while mechanically exfoliated graphene displays distinct graphene sheet.