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Hydrophobic cotton textile surfaces using an amphiphilic graphene oxide (GO) coating

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Highlights

- â€¢ Different GO dispersions were prepared by sonicating different amounts of GO in water. Degree of exfoliation of these GO sheets in water was analyzed using Atomic Force Microscopy (AFM).
- â€¢ AFM results obtained showed higher the GO concentration on water more the size of GO sheets and lesser the degree of exfoliation.
- â€¢ GO with different amounts was deposited on cotton fabric using simple dyeing method.
- â€¢ High GO loading on cotton increase the surface area coverage of the textile fibers with GO sheets. This led to less edge to mid area ratio of

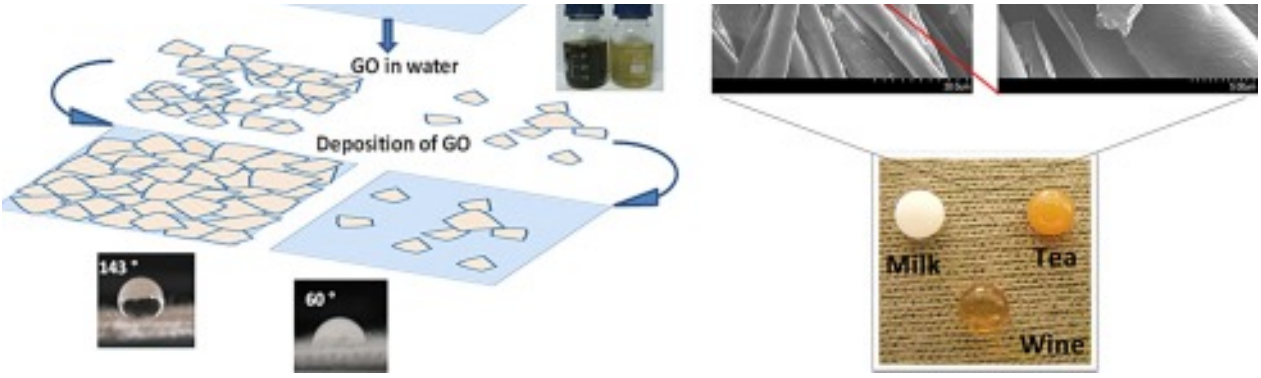
grafted GO sheets.

- â€¢ As contribution of mid area of GO increase on fiber surface cotton fabric becomes more hydrophobic.
- â€¢ Amphiphilic property of GO sheets was used to lower the surface energy of the cotton fibers leading to hydrophobic property.

Abstract

We report for the first time hydrophobic properties on cotton fabric successfully achieved by grafting graphene oxide on the fabric surface, using a dyeing method. Graphite oxide synthesized by oxidizing natural flake graphite employing improved Hummer's method showed an inter layer spacing of â^¼1Â nm from XRD. Synthesized graphite oxide was exfoliated in water using ultrasound energy to obtain graphene oxide (GO). AFM data obtained for the graphene oxide dispersed in an aqueous medium revealed a non-uniform size distribution. FTIR characterization of the synthesized GO sheets showed both hydrophilic and hydrophobic functional groups present on the nano sheets giving them an amphiphilic property. GO flakes of different sizes were successfully grafted on to a cotton fabric surface using a dip dry method. Loading different amounts of graphene oxide on the cotton fiber surface allowed the fabric to demonstrate different degrees of hydrophobicity. The highest observed water contact angle was at 143Â° with the highest loading of graphene oxide. The fabric surfaces grafted with GO also exhibits adhesive type hydrophobicity. Microscopic characterization of the fiber surface using SEM and AFM reveals the deposition of GO sheets on the fiber surface as a conformal coating. Analysis of the fabric surface using UVâ€“vis absorption allowed identification of the ratio of hydrophobic to hydrophilic domains present on the GO coated cotton fabric surface. Hydrophobic properties on cotton fabric are ascribed to two dimensional amphiphilic properties of deposited GO nano sheets, which successfully lower the interfacial energy of the fabric surface.

Graphical abstract



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Abbreviations

GO, graphene oxide; AFM, atomic force microscope; SEM, scanning electron microscope; XRD, X-ray diffractometer; FTIR, Fourier transformed infrared spectrophotometer; ATR, attenuated total reflectance; FE, field emission; MATLAB, Matrices Laboratory

Keywords

Cotton; Graphene oxide; Nano sheet; Amphiphilic; Interfacial energy; Hydrophobic

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