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Graphene modification for preparation of stable nanofluids

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Carbon-based nanomaterials, such as carbon nanotubes or graphene, are recognized to be excellent candidates for high performance materials. Graphene which is a layer of sp^2 hybridized carbon atoms with a thickness of only one atom possesses various magnificent properties that are not shared by other materials [1]. Their excellent intrinsic thermal properties have, in particular, led a strong interest for heat transfer applications [2]. However, dispersion of such material in water to prepare stable nanofluids is highly difficult. And the dispersion issue is pointed out to be the main reason for the reported disappointing and contradictory results in term of performance of such nanofluids [3]. Indeed carbon nanoparticles are usually strongly hydrophobic and tend to separate from the liquid medium, aggregate and sediment. Graphene being a new material, its efficient and controlled surface modification is still challenging. Our paper proposes different ways to chemically modify the properties of graphenic materials in order to increase their hydrophilic character improving that way their dispersion. Chemical reactivity of graphene upon the applied treatments was deeply analyzed based on the carried out multi-scale characterization of the modified graphene. We will discuss graphene reactivity in comparison with other nanostructured carbon materials. Rheological properties of the prepared graphene dispersions will be presented and discussed regarding the practical use of such dispersions under flowing conditions for heat transfer applications.

Keywords: carbon nanomaterials, chemical modification, nanofluid, heat transfer

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