Functionalized Graphene Oxide with Excellent Dispersion and Stability as a New Emerging Lubricant Additive

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Abstract

Graphene oxide (GO) has been proven to be viable in lubricant as a friction modifier [1]. However, the main concern of adding nano-particle, is how well it can remain well dispersed and stable in the lubricant. Studies have shown that GO or functionalized GO possesses a good dispersion in lubricant [2][3],but long term stability of the dispersion were not reported. Due to its hydrophilicity, GO is not compatible in lubricant, making it challenging for the nanoparticle to remain dispersed and stable for a sufficient period of time. However, taking an advantage of oxygen functional group in GO, functionalization can be done to tackle this problem. In this study, GO was functionalized using oleophilic types of silane, in which the functionalization of GO is through silanization reaction. The functionalization was accomplished by reaction of hydroxyl in GO with the silanol group of the silane agent. It is worth noting that, one of the criteria for the nanoparticle to remain stable in the medium is to have a long hydrocarbon chain and a polar head. The former will assists the nanoparticle to dispersed and remain stable in the lubricant, while the latter will attach to metal/solid materials during lubrication. Herein, after functionalization, analysis of FTIR and XPS have shown an introduction of a new functional group from the silane agent, thus proved the successful functionalization of GO. Subsequently, the functionalized GO was dispersed in lubricant via sonication aid. The result was a very well dispersed of the nanoparticle in the lubricant and most importantly, the stability of the nanoparticle improved as opposed to GO without functionalization. The silane-functionalized GO was able to remain stable for more than 14 days without any sedimentation and works is still on going to further improve the stability. Following to that, the tribological performance of stable functionalized GO will be tested accordingly.

References

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Figure

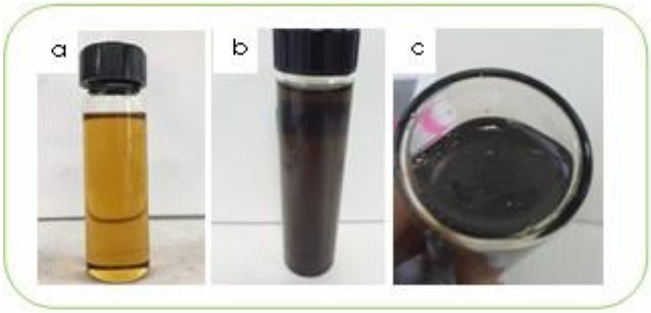

Figure 1: a) neat lubricant; b) well dispersed functionalized GO in lubricant; c) excellent dispersion with clear bottom of vial without apparent sedimentation of functionalized GO.