Modified graphene and graphite oxide dispersions in petroleum fractions.

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Abstract

This presentation exhibits results of research on the synthesis of modified structure graphite oxide (GO) and graphene, and their tendency to form dispersions in hydrocarbon fractions represented by diesel oil fraction and base oil SN 400. GO was obtained by modified method described by Hummer [1]. Graphite oxide consists of covalently attached oxygen-containing groups such as hydroxyl, epoxy (oxirane), carbonyl and carboxyl groups.

Scheme 1

The presence of these functional groups makes GO susceptible to various chemical modifications. Organophilic graphite oxide and graphene nanosheets dispersions were prepared by multistep process according scheme 1. The used reagents and obtained structures were depicted in table below.

Graphite oxide functional group	Reaction with $SOCl_2$	Modified GO structure formed in reaction with $SOCl_2$	Reagent X	Modified GO/graphene structure formed in reaction with reagent X
-COOH	+	GO-COCl	$R\text{-}NH_2$	$GO\text{-}CONH_2R$
-COOH	+	GO-COCl	R-ONa	GO-COOR
-COOH	-	-	propylene oxide	$GO\text{-}COO(CH(CH_3)\text{-}CH_2O)_nH$
C-OH	+	GO-Cl	$R\text{-}NH_2$	GO-NH-R
C-OH	+	GO-Cl	R-ONa	GO-O-R
C-OH	-	-	R-NCO	GO-NH-COR
C-OH	-	-	$(R\text{-}CO)_2O$	GO-OOC-R
C-OH	-	-	propylene oxide	$GO\text{-}O\text{-}(CH(CH_3)\text{-}CH_2O)_nH$
oxirane	-	-	R-ONa	GO-C(OR)-C(OH)-GO
oxirane	-	-	$R\text{-}NH_2$	GO-C(NHR)-C(OH)-GO

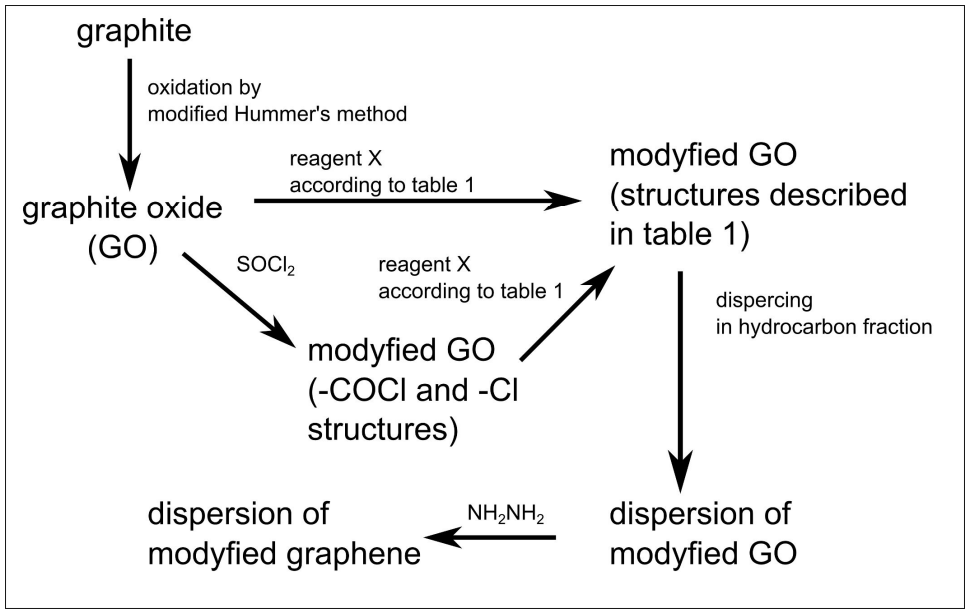
The organophilic graphite oxide based products were characterized by FTIR spectroscopy.
Obtained dispersions properties were characterized by the Zeta Sizer, the Turbiscan measurements.
The dispersions of nanomaterials in diesel oil were hard to obtain, and their stability was poor.
In the dispersion of modified graphene oxide in the diesel oil in most cases during reduction a significant decreasing the number and size of dispersed particles were observed. Dispersions in lubricant base oil SN 400 are more stable. During the reduction is not observed a significant decrease the number and size of suspended particles.

References

[1] W.S. Hummers, R.E. Offeman, J. Am. Chem. Soc. **80** (1958) 1339.

Figures

Scheme 1


graphite
oxidation by
modified Hummer's method
graphite oxide
(GO)
reagent X
according to table 1
modyfied GO
(structures described
in table 1)
SOCl2
reagent X
according to table 1
modyfied GO
(-COCl and -Cl
structures)
dispercing
in hydrocarbon fraction
dispersion of
modyfied graphene
NH2NH2
dispersion of
modyfied GO