

Composite films based on graphene oxide and fluorographene suspensions mixture

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New perspective, composite, graphene-based dielectric layers were suggested. The layers were obtained from a mixed composite of fluorinated graphene (FG) and graphene oxide (GO) suspensions. The problem of creating insulating and thermally stable inks using graphene suspension is very important for the development of inkjet printing technology. So, the investigated mixture may be used for dielectric ink preparation and most likely become a significant step for the graphene inks technology.

Graphene oxide suspension is a rather known material for the creation of large-area films. Unfortunately, graphene oxide films are thermally unstable and begin to reduce at 100°C. Fluorographene is more thermally stable than GO, the reducing processes begin at ~ 480°C. The difficulties of traditional fluorination methods limit the FG utilization extremely. We suggested an original method of the fluorination in aqueous solution of hydrofluoric acid [1]. One more attractive feature of the suggested fluorination process is a splitting off for initial graphene flakes and their fragmentation in finer flakes taking place during the fluorination treatment.

The interaction between GO and FG flakes affects the structural and electrical properties of the films produced from the suspension mixture. The FG influence suppresses the reduction processes for GO particles and increases thermal stability of the films. The films demonstrate excellent electrical properties for a wide range of the GO/FG ratio. The films display very low charge densities in the film and at the interface with a silicon substrate in metal-insulator-semiconductor structures ($\sim (0.4-1) \times 10^{10} \text{ cm}^{-2}$).

The films obtained from the mixture of fluorinated and oxidized graphene suspensions are cheap, practically feasible and easy to produce. Low size and high degree of flakes splitting in FG allow us to use a limited volume of the FG suspension in comparison to the GO one for drastical modulation of mixed film properties. Also, the composite suspension suggests its use as a perspective substance for inkjet inks for printing nano- and microelectronic devices.

References

[1] Nebogatikova, N. A., Antonova, I. V., Prinz, et. al. (2015). Fluorinated graphene dielectric films obtained from functionalized graphene suspension: preparation and properties. *Physical Chemistry Chemical Physics*, 17(20), 13257-13266.