

**STUDY OF THE MORPHOLOGICAL AND STRUCTURAL
CHARACTERISTICS OF HIGHLY OXIDIZED GRAPHENE OXIDE**

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Highly oxidized graphene oxide (GO) is characterized by a layered structure and a high density of oxygen-containing functional groups on its surface. A high degree of oxidation affects the morphology, interlayer distance, and aggregation behavior of GO. Therefore, studying its morphological structure is of great importance for assessing the structural and functional properties of the material.

Layered Morphology of Highly Oxidized Graphene Oxide. Highly oxidized graphene oxide is characterized by a specific layered morphology consisting of thin and few-layered sheets. The relatively small number of layers in the sample indicates that they are partially separated from each other. In some cases, individual GO sheets can also be observed, which may be associated with changes in interlayer interactions resulting from the oxidation process. Highly oxidized GO sheets are distinguished by their smooth, transparent, and relatively uniform surfaces. At the same time, twisted and wavy structures may be observed at the edges of the layers. Such morphological changes are associated with interactions between the functional groups formed on the GO surface as a result of the high degree of oxidation.

Changes in Interlayer Distance and Reduction in Aggregation. In highly oxidized GO, the high density of functional groups is considered one of the main factors contributing to an increase in the interlayer distance. The spatial arrangement of functional groups limits the close approach of the layers and reduces the probability of their mutual aggregation. This morphological feature contributes to maintaining the individual layers of highly oxidized GO in a relatively stable state. The presence of layers in a relatively separated state indicates that the material surface is rich in functional groups and that the structural changes resulting from the oxidation process are preserved.

Relationship Between Functionalization and Morphological Changes. A high degree of oxidation affects not only the chemical composition of GO but also its morphological structure. The high density of functional groups on the surface leads to an increase in the interlayer distance and a reduction in aggregation. Twisted and irregular structures at the edges of the layers are associated with interactions between functional groups and represent characteristic morphological features of highly functionalized GO.

Highly oxidized GO possesses a layered structure consisting of few-layered, smooth, and transparent sheets. The high density of functional groups on its surface increases the interlayer distance and reduces aggregation. The twisted and wavy structures observed at the edges of the layers are associated with a high degree of oxidation and functionalization. The obtained results indicate that the synthesized material is highly oxidized graphene oxide rich in functional groups.