ADSORPTION AND PHOTOTHERMAL DESORPTION OF HID MOLECULES IN GRAPHENE-BASED NANOMATERIALS

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Abstract: This article examines the properties of graphene-coated fabric in adsorbing volatile organic substances (odor) and desorbing them under external influences. Research indicates that the high surface area and active surface of graphene ensure its effective absorption of gas and odor molecules [1]. Under the influence of heat and light, these molecules are separated from the surface, which is explained by the process of photothermal desorption [4].

Key words: graphene, adsorption, desorption, photothermal process, VOC sensors

1. Introduction

In recent years, graphene-based nanomaterials have been widely used in gas sensors and odor detection systems. This is due to the very large surface area and high sensitivity of graphene, which ensures high efficiency in the detection of volatile organic compounds (VOCs). The interaction of gas molecules with the graphene surface is primarily carried out through **adsorption** and **desorption** processes. The kinetics and reproducibility of these processes determine the operating principle of graphene-based sensors [5].

Graphene properties.Graphene is a two-dimensional carbon structure with the following main properties:

- Very large surface area (~2630 m2/g)
- High electrical and thermal conductivity
- Chemical sensitivity
- High adsorption capacity

Recent studies show that graphene oxide and materials based on it have high efficiency in adsorbing organic substances [3]. It has also been established that graphene-based textile materials are capable of rapidly absorbing VOC molecules and releasing them again [2].

Theory of photothermal desorption

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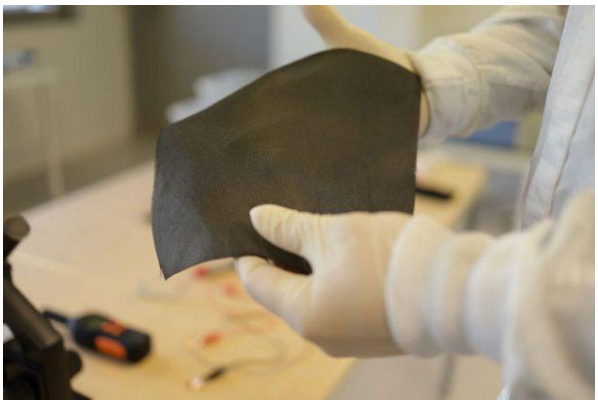
Photothermal desorption is the process of molecules separating from the surface of a material under the influence of light or heat.

Due to its high thermal conductivity, graphene quickly absorbs external energy and accelerates the separation of molecules adsorbed on the surface [4]. This process plays an important role in increasing the recovery rate of sensors.

Scientific studies have shown that adsorption-desorption processes in graphene-based systems can be effectively controlled through photothermal effects [4].

Experimental methodology

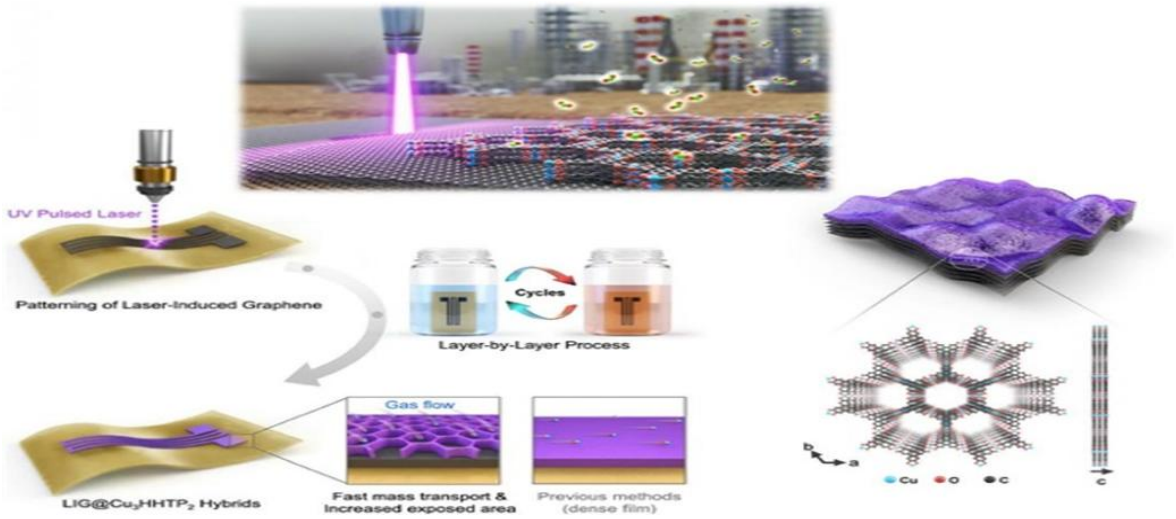
For the experiment, a graphene-covered fabric measuring 10×10 cm was taken and divided into 4 equal parts. Each part was placed in an airtight container with a separate aromatic substance (tea, mint, spices), and one part was left as a control.





The sample was stored in a closed environment for 5 days, which allowed for the adsorption of molecules on the material surface. It has also been confirmed in the scientific literature that graphene materials effectively absorb VOCs under similar conditions [2]. Subsequently, the fabrics were released into the open air and the degree of odor retention was assessed. Using the sensory assessment method, participants detected odors. Partial separation of molecules was observed during mechanical stimulation, which is related to the kinetic properties of adsorption-desorption processes[5].

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Results and discussion

The experimental results showed that the graphene fabric effectively absorbs odor molecules, which is explained by its large surface area [1]. The decrease in odor in the open air, but not its complete disappearance, indicates that the molecules are partially tightly bound to the surface. These results are consistent with modern studies demonstrating the high efficiency of graphene-based adsorbents [3]. The decrease in odor resulting from mechanical action indicates the separation of molecules from the surface. The most significant result was observed during thermal action: the reappearance of odor was detected upon heating at 400°C. This process confirms that desorption occurs under the influence of heat and is explained by a photothermal mechanism [4].

Conclusion

Graphene adsorbs odor molecules with high efficiency. In an open environment, the odor is partially preserved. Mechanical action intensifies the desorption process. The thermal/photothermal effect reproduces the odor.[4] Graphene-based materials are promising for gas sensors.[2]

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