NO_2 resistive sensor

Romanian Patent Application A00363, RO, OSIM, 10.07.2023

AGEPI AGENȚIA DE STAT PENTRU PROPRIETATEA INTELECTUALĂ A REPUBLICII MOLDOVA

Expoziția Internațională Specializată INFOINVENT

22-24 noiembrie 2023
Ediția a XVIII-a

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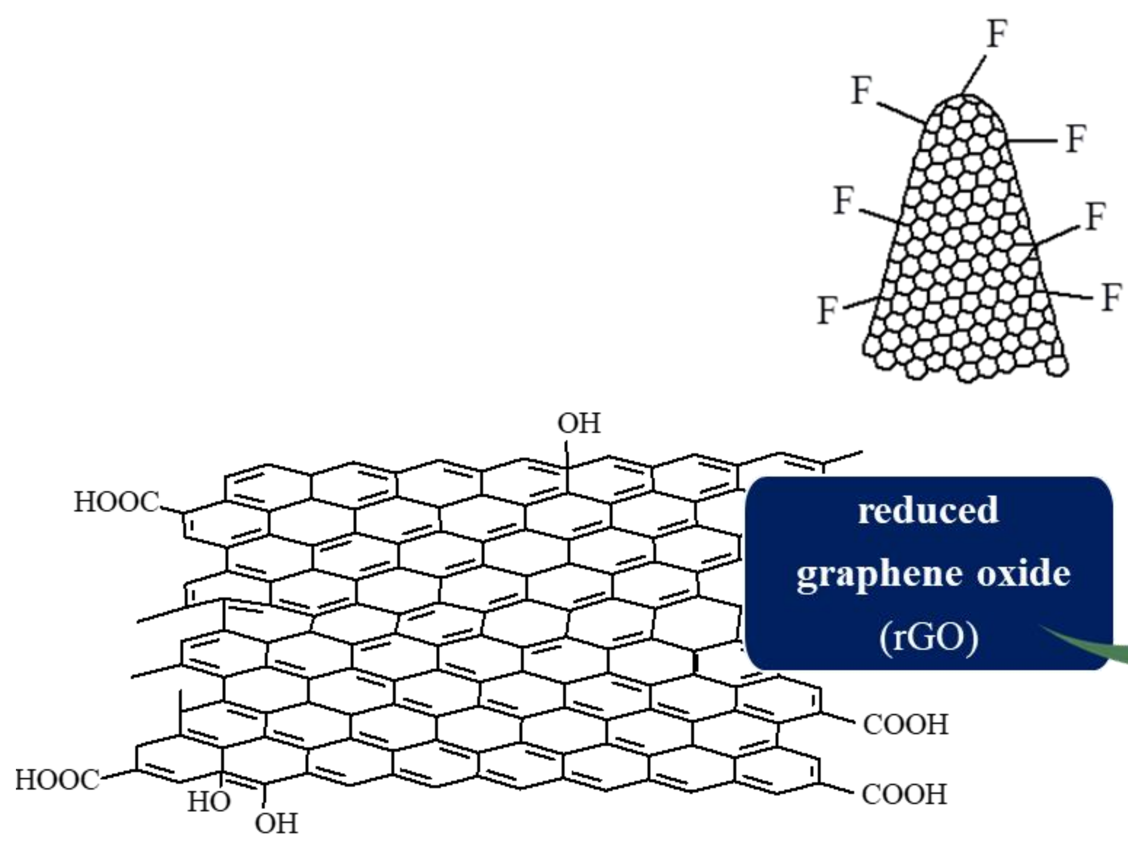
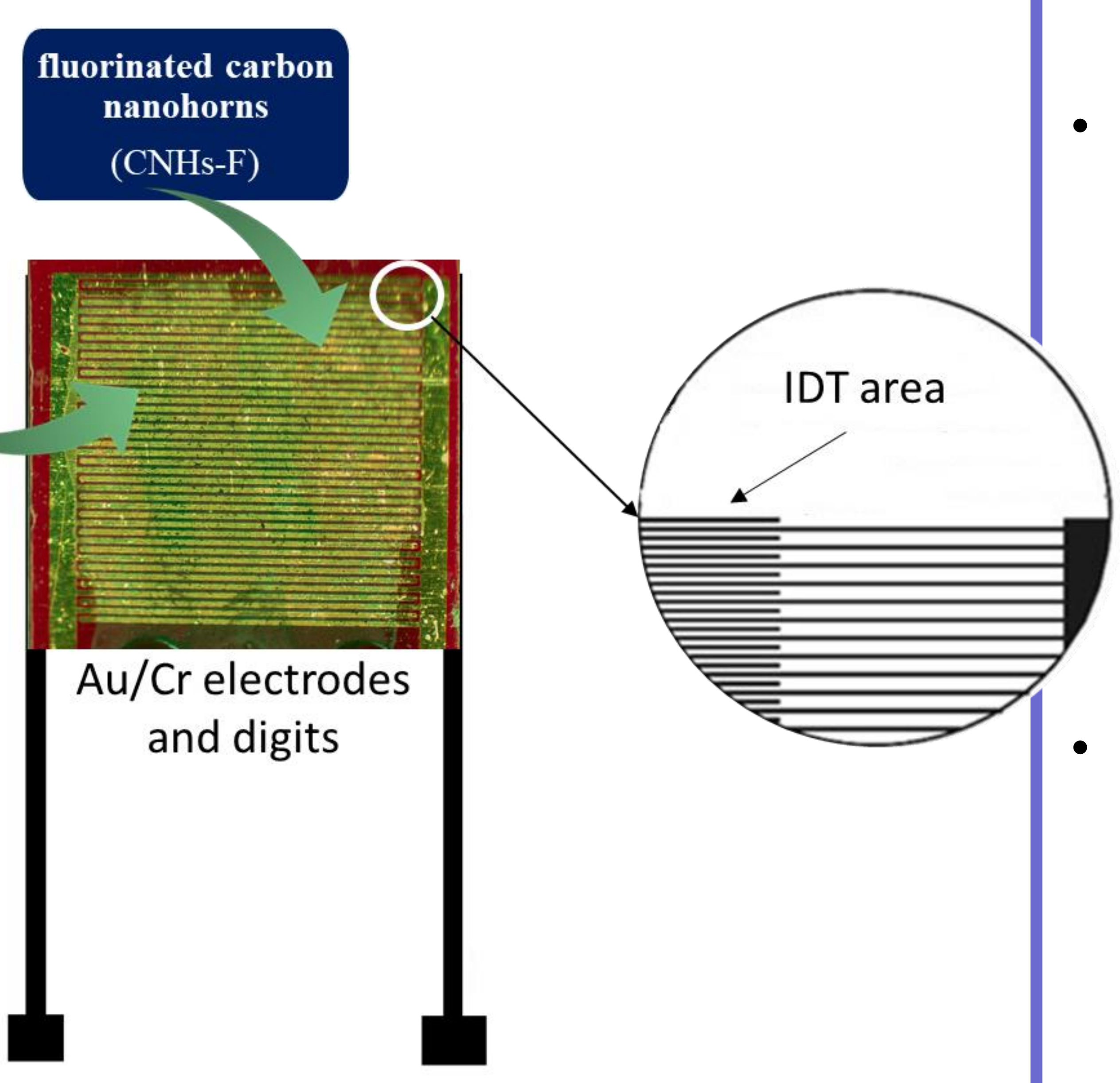
Field of Invention

Nitrogen dioxide (NO_2) is a significant air pollutant with harmful effects on human health and the environment. The increasing awareness of the health and environmental impacts of nitrogen dioxide (NO_2) has led to the development and growth of the NO_2 sensor market. As the need for monitoring and controlling NO_2 emissions has become more significant, several factors have contributed to the remarkable development of this market in recent decades: (a) environmental regulations and air quality standards have been implemented in many regions, which mandate the monitoring of NO_2 levels in all areas, especially in areas with high pollution levels, (c) industries that produce NO_2 emissions, such as automotive, power generation, and manufacturing, require sensors to comply with emission standards and to optimize their processes, (d) the emergence of Internet of Things (IoT) and the concept of smart cities has led to the integration of NO_2 sensors into urban infrastructure for real-time monitoring and data collection. This data can be used to improve public health and reduce pollution.

Architecture of a sensing device with interdigitated electrodes





Sensing structure

The sensitive layers made of fluorinated carbon nanohorns (CNHs-F) / reduced graphene oxide (rGO) mixture is deposited on the SiO_2 substrate (interdigitated structure).

Sensor manufacturing

- the synthesis of fluorinated carbon nanohorns is carried out by plasma treatment of F_2 and N_2 (volume mixture 1:10) at a pressure of 0.5 bar, in a nickel reactor, at room temperature.
- the dispersion of fluorinated carbon nanohorns is prepared by dissolving CNHs-F in isopropyl alcohol, under magnetic stirring for three hours, at room temperature.

  reduced graphene oxide is added to the dispersion obtained previously, under magnetic stirring for three hours, at room temperature.
- the obtained dispersion is deposited by the drop casting method using a Kapton substrate with linear electrodes or with interdigitated electrodes (after masking the contact area beforehand).
- the sensitive layer obtained is subjected to a thermal treatment at 120 ^{0}C, for four hours, in a vacuum.

Original approach

The sensitive layers described in this invention, which can be used to obtain resistive NO_2 sensors, are nanocomposite matrices made with fluorinated carbon nanohorns (CNHs-F) and reduced graphene oxide (rGO). From the point of view of the detection principle, the resistance of the sensitive layer varies with the NO_2 concentration level.

Advantages of the proposed sensing device

- fluorinated carbon nanohorns and reduced graphene oxide give a high specific surface / volume ratio, as well as a variation in the resistance of the sensitive layer upon contact with NO_2 molecules;
- the presence of fluorine atoms minimizes the effect of humidity on the resistance variation of the sensitive layer as a consequence of their hydrophobic effect, ;
- due to the increased electronegativity, the fluorine atoms increase the polarity of the surface of the nanocarbon material, creating temporary dipoles that facilitate the interaction with NO_2 molecules.
- graphene oxide acts as a dispersant for the fluorinated carbon nanohorns ensuring superior homogeneity and improved morphology of the film sensitive to NO2 molecules.
- chemical and thermal stability;
- superior mechanical properties;
- detection at room temperature.

Acknowledgments: Participation to Infoinvent 2023 is granted by project ID584/2021, 43PFE/30.12.2021, Excellence and Performance for Increasing the Institutional Capacity of RDI (ProExcellence), financed by the Ministry of Research, Innovation, and Digitization, and project CNFIS-FDI-2023-0048, Start-Inov: Research and Innovation as an interface for preparing a sustainable competitive environment, financed by the Romanian Ministry of Education.