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MATRIX NANOCOMPOSITE FOR RESISTIVE OXYGEN SENSOR

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INTRODUCTION

Oxygen concentration monitoring is a process of paramount importance in various fields of industrial and domestic activity such as indoor air quality control (air conditioning and ventilation systems), combustion optimizing in industrial boilers, pollution control through automobile engine management, food processing plants.

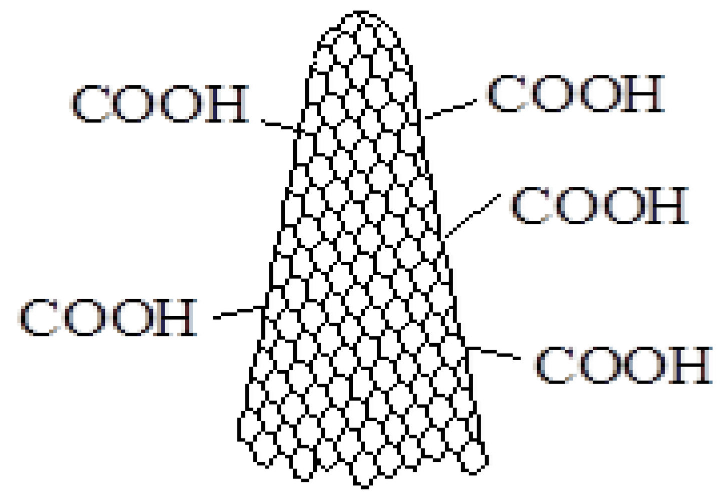

Fig.1 Structure of oxidized carbon nanohorns (CNH_{OX})

ORIGINAL APPROACH

This invention includes the design and manufacturing processes for a new resistive, room temperature oxygen sensor, employing organic - inorganic halide perovskites ($CH_3NH_3PbI_3$)/oxidized carbon nanohorns (CNHox) (Fig.1) nanocomposite as sensing layer.

The oxygen sensor includes a Kapton substrate, interdigitated electrodes and a sensing layer obtained via spin coating method (Fig.2 and 3).

The oxygen monitoring capability of the sensing layers was investigated by applying a current between the two electrodes and measuring the voltage at different values of the oxygen concentration at which the sensing layer was exposed.

The resistance of the sensitive layer varies with the oxygen concentration.

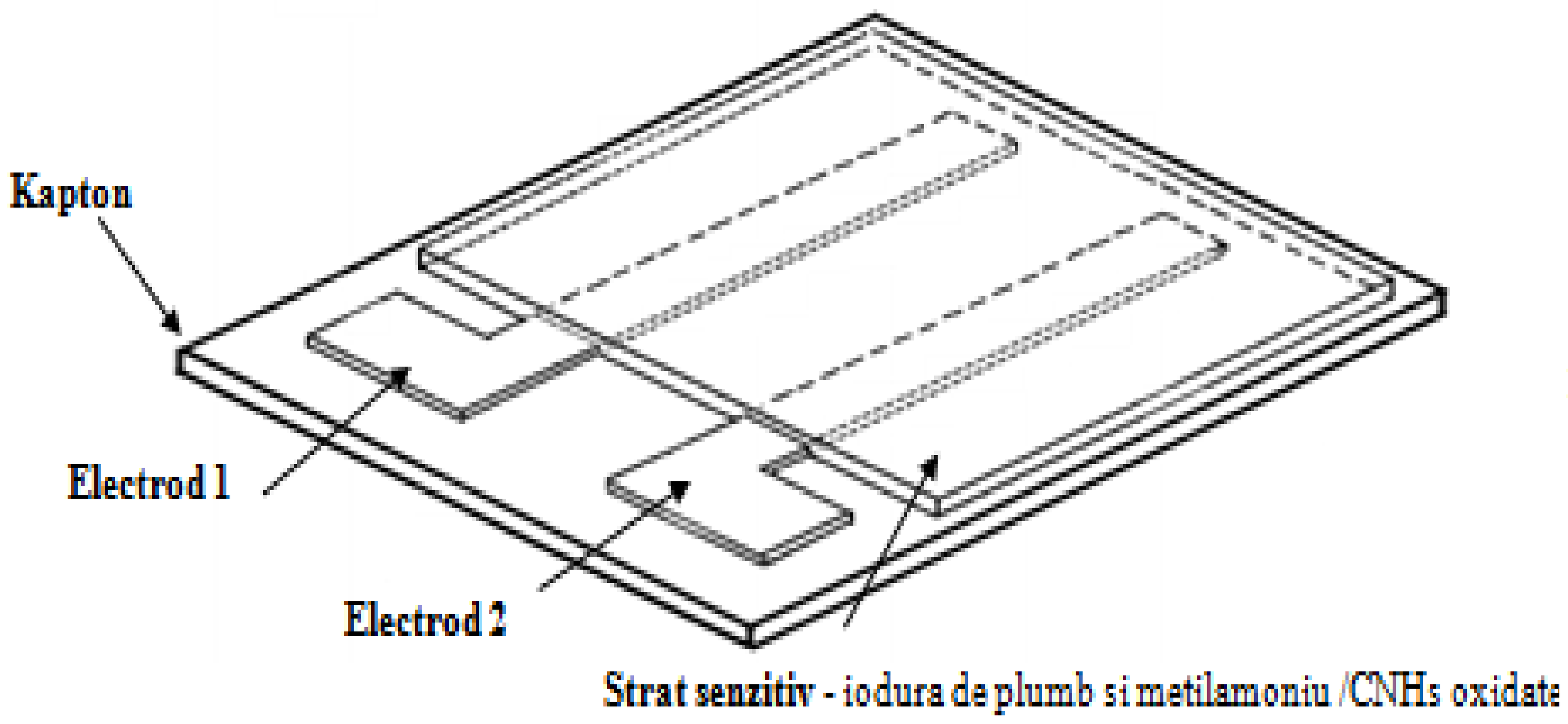

Fig.2 Structure of the sensor with planar, linear electrodes

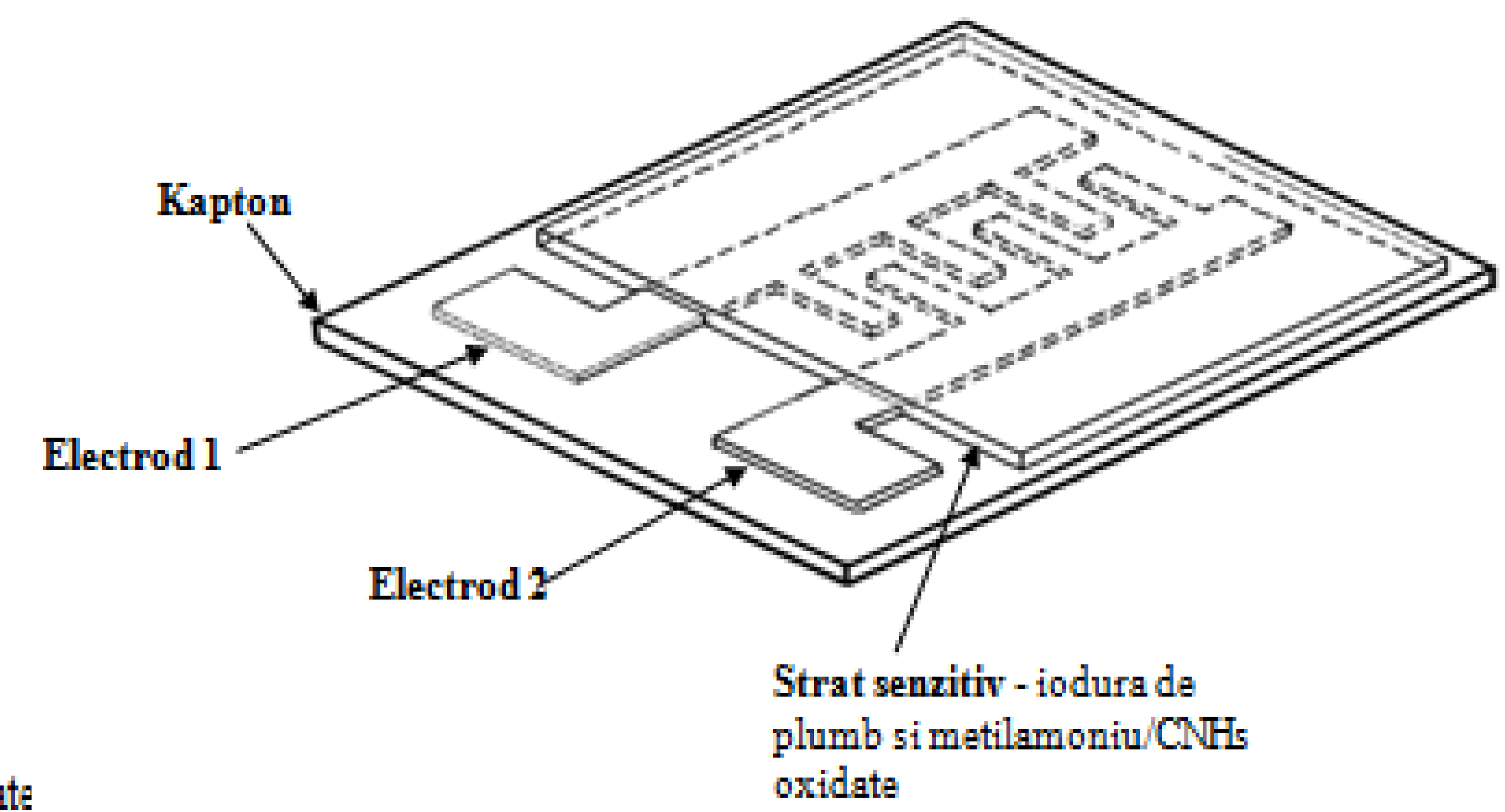

Fig.3 Structure of the electrodes with interdigitated configuration

SYNTHESIS OF SENSING LAYER

1.The Kapton substrate is cleaned for 10 minutes in an ultrasonic bath using deionized water.

2. A solution of oxidized carbon nanohorns (0.15 mg / mL) in isopropyl alcohol is prepared and subjected to ultrasonication for 2 hours.

3. The solution obtained is deposited by the "spin coating" method (2000 rpm for 30 seconds) using a Kapton substrate with linear electrodes or interdigitated electrodes (after previously masking the contact area).

4. 200 µL 0.55M solution of PbI_2 in dimethylformamide (DMF) is mixed with 600 µL solution CH_3NH_3I in dimethylformamide and subjected to magnetic stirring for 3 hours at 60 °C.

5. The solution obtained is deposited by the "spin coating" method (1500 rpm for 15 sec; 3000 rpm for 60 sec) on the Kapton substrate over which the oxidized carbon nanohorns were initially deposited.

6. The obtained layer is subjected to a heat treatment at 100 °C, 30 minutes.

7. Halogenated perovskite penetrates the nanocarbon structure forming a hybrid structure CH_3NH_3PbI3 / oxidized carbon nanohorns.

ADVANTAGES OF THE PROPOSED SENSING SOLUTION

The new synthesized sensing layer used in the manufacturing of resistive oxygen sensor have several significant advantages:

- the presence of CNHs-ox ensures a high specific surface area / volume ratio as well as a substantial affinity for oxygen molecules;
- detection at room temperature ;
- rapid response of the sensor to variations in the value of oxygen concentration.