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RESISTIVE HYDROGEN SULPHIDE SENSOR

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INTRODUCTION

The invention includes the design and manufacturing processes for a resistive hydrogen sulphide sensor, employing carbon nanoonios functionalized with mercapto groups (-SH) and carbonothioyl (-C=S) groups (abbreviated as CNO-SH, Fig.1).

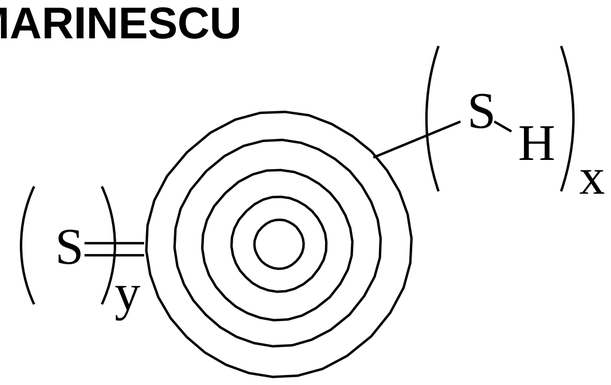

Fig. 1 Structure of CNO-SH

ORIGINAL APPROACH

- The sensing layers described in this invention are based on carbon nanoonios subjected to H_2S / He plasma.
- The optimal degree of derivatization of carbon nanoonios, in order to obtain high sensitivities, can be tuned by changing the plasma power as well as the exposure time.
- The H_2S monitoring capability of the sensitive layers was investigated by applying a current between the two electrodes and measuring the voltage at different values of the H_2S concentration at which the mercapto carbon nanoonions based sensing layer was exposed (Fig.2)
- The resistance of the sensitive layer varies with the H_2S concentration.

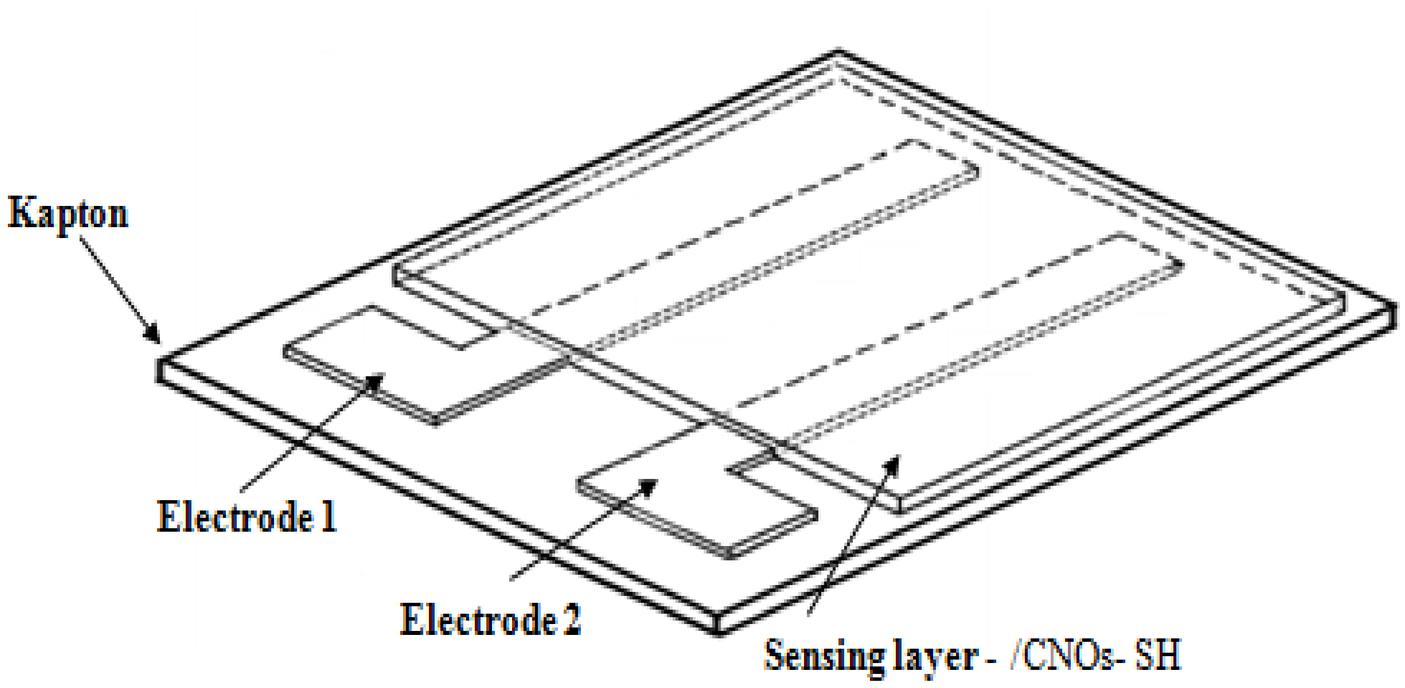

Fig. 2 Structure of the sensor with planar, linear electrodes

SYNTHESIS OF SENSING LAYER

The process steps for the fabrication of the solid-state sensing films based on CNO-SH are shown below:

- The Kapton substrate is cleaned for 10 minutes in an ultrasonic bath using deionized water;
- Onion type nanocarbonic materials are synthesized from nanodiamond by heating at 1650 ^oC, in helium atmosphere;
- Carbon nanoonios, are functionalized in H_2S / He plasma (60-40 v/v);
- The synthesized CNO-SH is washed with ethanol, acetone and deionized water;
- A dispersion of CNO-SH in dimethylformamide was subjected to ultrasonication at room temperature for 24 hours;
- The obtained dispersion is deposited by the spin coating method on the Kapton substrate;
- The obtained film is heated to 100 ^oC for 30 minutes;
- The obtained film is subjected to a final heat treatment, at 150 ^oC, for 10 minutes.

ADVANTAGES OF PROPOSED SENSING SOLUTION

The use of functionalized nanoonios films gives the sensor several significant advantages:

- superior mechanical properties;
- the presence of CNOs-SH confers a high specific area / volume ratio, affinity for H_2S molecules through van der Waals type interactions as well as a variation of the resistance of the sensitive layer to contact with them;
- rapid response of the sensor to changes in the value of H_2S concentration;

room temperature detection;

- reversibility.

ADVANTAGES OF PROPOSED SENSING LAYERS

- Improved mechanical properties and better processability of the sensing layer;
- A high specific area / volume ratio, affinity for H_2S molecules through van der Waals - type interactions ("mass loading"), as well as a variation of the resistance of the sensitive layer to contact with them ("electric loading");
- Detection at room temperature;
- Fast response;
- Increased selectivity.