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Nanohybrid ternary formulation for relative humidity chemoresistive sensing devices

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Field of invention:

A complex gaseous mixture results in storage premises of fresh fruits and vegetables due to respiration and transpiration processes, and depending of the plant type, climacteric / non-climacteric. The phytochemical characteristics and organoleptic properties of stored fresh products may change depending on the atmosphere in the storage facilities containing humidity, CO_2, O_2, ethylene and other volatile organic compounds. The humidity of the air in the storage spaces or containers is a defining parameter for keeping the plant products in good condition, as it strongly correlates with respiration and transpiration rates.

Narrowly monitoring and control of the relative humidity (RH) in spaces and/or containers for storage of fruits and vegetables may ensure prolonging the products quality shelf-life and market value, and implicitly reducing the food waste generation. Thus, the two metabolic processes of fresh products, respiration and transpiration, may be carefully limited while not-stopped.

RH sensitive layers manufacturing and testing:

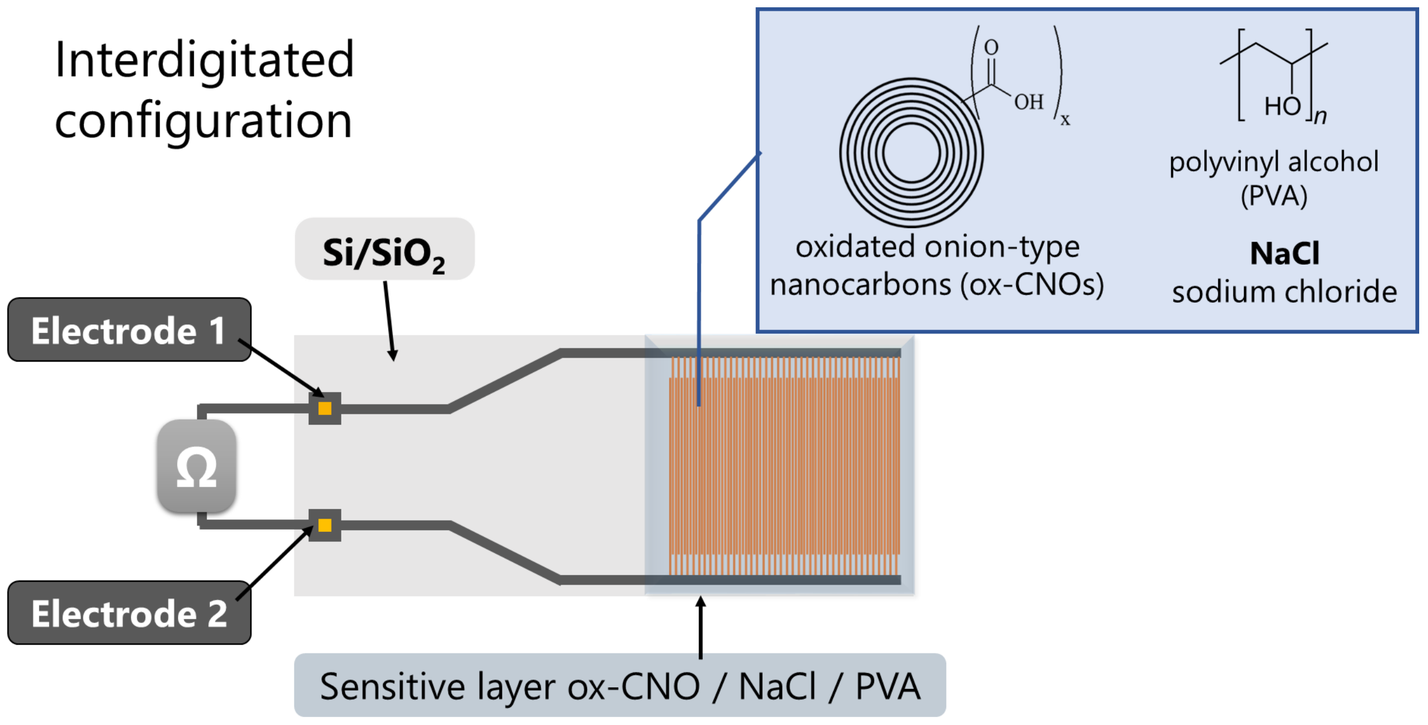
- the ternary nanohybrid can be deposited by the drop casting method on linear or interdigitated electrodes made of Kapton or poly-ethylene-terephtalat (PET); the assembly is then thermally treated at 90 °C under vacuum conditions;
- the electrodes were connected by the successive deposition of Cr (10 nm) and Au (100 nm);
- the relative humidity monitoring capability was investigated by applying a constant current between the two electrodes and measuring the voltage at different values of the relative humidity levels of the testing environment

Original approach:

The invention refers to new ternary nanohybrid formulation suitable for use as sensing layers in chemoresistive devices for monitoring relative humidity.

- The ternary nanohybrid formulations contain oxidated onion-type nanocarbons (ox-CNOs), sodium chloride (NaCl) and polyvinyl alcohol (PVA) which may form conductive layers
- Detection principle relies on variation of this conductive layer resistance with the level of relative humidity in the monitored environment
- Synthesis of the carbonaceous materials onion-type consists in thermal treatment of the nanodiamond at 1650 °C in helium environment, followed by oxidation in water-plasma @ 5 torr and room temperature
- The nanocomposite ox-CNO / NaCl / PVA is obtained by mixing the components in deionised water, and ultrasonication at 80 °C

RH chemoresistive device with ox-CNO / NaCl / PVA sensing layer



Advantages:

- ternary nanocomposites formulation of ox-CNO/ NaCl / PVA offer notable advantages in RH resistive detection;
- ox-CNOs offer high specific surface / volume ratio, affinity for water molecules, and notable resistance variation of sensitive layers at contact with water molecules throught the RH range;
- polyvinyl alcohol is a hydrophilic polymer exhibiting low hysteresis;
- the presence of sodium cations Na^+ (hard acids according to Hard Soft, Acids and Bases theory) gives the ternary nanohybrid an increased sensitivity, by increasing the number of active sites available for an interaction with water molecules;
- detection at room temperature.

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