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Novel Relative Humidity Sensor

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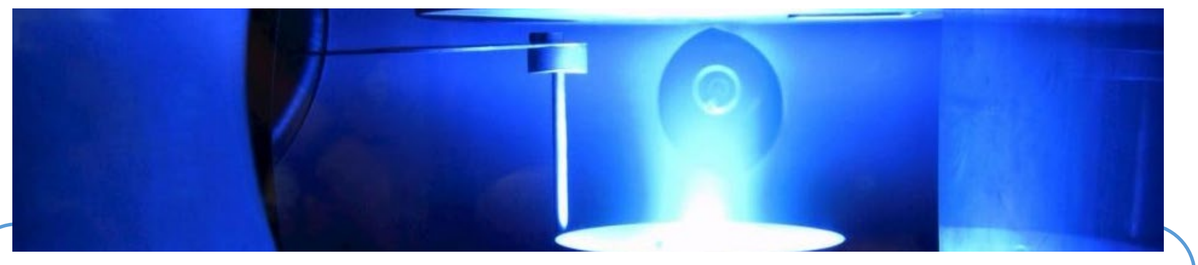
Scope:

Design and manufacturing of new chemiresistive humidity sensors using conductive polyaniline - Kollidon® SR nanofibers as sensing layer.

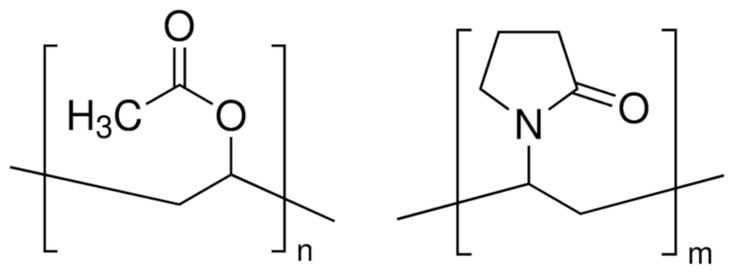


Original approach:

- chemiresistive humidity sensors are devices that change their electrical resistance in response to changes in humidity levels;
- polyaniline is a conducting polymer that undergoes changes in its electrical conductivity when exposed to moisture;
- nanofibers of polyaniline have a high surface area-to-volume ratio, and this characteristic may contribute to enhancing the sensitivity and response time;
- the use of nanofibers of polyaniline increases the surface area available for moisture adsorption;
- this high surface area / volume ratio amplifies the sensitivity of the sensor; even small changes in humidity levels can result in noticeable changes in electrical resistance, making the sensor highly responsive;
- specific porous structure of the polyaniline nanofibers allows a rapid diffusion and adsorption of moisture molecules, and thus leading to quick response time of the sensor;
- polyaniline nanofibers are known for their stability over time when exposed to humid environments, and this property is crucial for the long-term performance of a humidity sensor; this stability is attributed to the reversible nature of the polyaniline's conductivity changes in response to moisture

Sensor architecture:

- Components of the chemiresistive relative humidity sensor:
  - the dielectric substrate (Lexan)
  - two electrodes (Al / Cu / Cr)
  - the sensing layer
- Synthesis of conducting polyanilines is performed by doping emeraldine with:
  - H_2PO_3-PEG5K-COOH (Mw = 5000), and
  - poly(vinyl phosphonic acid-co-acrylic acid)
- The electrodes are deposited onto the surface of the dielectric substrate by different methods:
  - sputtering, and
  - direct printing
- The synthesized nanocomposite is deposited onto interdigitated electrodes through an electrospinning technique
- The conductive nanocomposite-based sensing layers were investigated by applying a voltage between the two electrodes and measuring the electrical current flowing through the sensitive layer at various levels of humidity.



Kollidon® SR

Advantages of the novel relative humidity sensors:

- H_2PO_3-PEG5K-COOH and poly (vinyl phosphonic acid-co-acrylic acid) contain acidic groups and can protonate imine nitrogen atoms in the emeraldine structure to form stable conductive polyanilines; both act as poly-dopants, are thermally stable, and do not rise risks to the environment;
- due to the large size counter-ion, polyanilines doped with H_2PO_3-PEG5K-COOH and poly (vinyl phosphonic acid-co-acrylic acid) are less susceptible to the dedoping;
- H_2PO_3-PEG5K-COOH and poly (vinyl phosphonic acid-co-acrylic acid) improve the mechanical properties and processability of polyanilines;
- Kollidon® SR is hygroscopic and improves the mechanical and film properties of doped polyaniline.

Acknowledgments

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