Zinc Oxide Nanoparticles on Surface Modified Polyvinylidene Fluoride for Ammonia (NH_3) Detection

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WHY IS AMMONIA DETECTION IMPORTANT?

- Concentrations **exceeding 50 ppm** cause temporary blindness and body irritation.
- Accurate measurement of NH_3 gas **has been in demand** to prevent fatal accidents caused by overexposure.
- Hazardous gas **present in the atmosphere**, mainly originating from the chemical industry.
- NH_3 could jeopardize human health and **give life to dangerous illnesses**.

WHY USE ZINC OXIDE NANOPARTICLES?

Zinc Oxide (ZnO)

Advantages	Disadvantages
• An important representative of metal oxide semi-conductor • Results were remarkable, particularly for **hydrogen**, **ethanol**, and **ammonia** at • Room Temperature • **Commonly used** as sensing material	• To obtain results an energy input is needed (coming from **thermal energy or UV excitation**). • **Higher energy consumption (3.37 eV)** • **Lack of sensitivity** at room temperature

SYNTHESIS OF ZNO: THE HYDROTHERMAL METHOD

Hydrothermal Method

(method of synthesis of single crystals that depends on the solubility of minerals in hot water under pressure)

Advantages

- **Most used** for gas sensing
- **Fastest** gold sputtering time (10 seconds)
- Does **not require** the use of grinding and calcination
- **One-step synthetic procedure**
- **Environmental friendliness**
- **Good dispersion in solution**
- Operates at **high temperatures**

Disadvantages

- **The process requires high capital investment**
- **Longer reaction time** (3 hrs., 6.5 hrs., 10 hours)
- **Possible corrosion**

HYDROTHERMAL METHOD OF ZINC OXIDE SYNTHESIS

Fig. 1– Synthesis of ZnO Nanoparticles through Hydrothermal Method

WHAT RESULTS DO YOU EXPECT TO SEE?

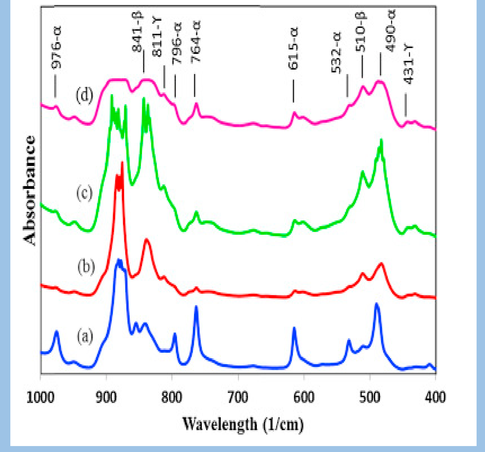

Fig. 2 – FTIR of pure PVDF (a), PVDF/RGO-ZnO (2:1) (b), PVDF/RGO-ZnO (4:1) (c) and PVDF/RGO-ZnO (1:1) (d) 1% nanocomposites.

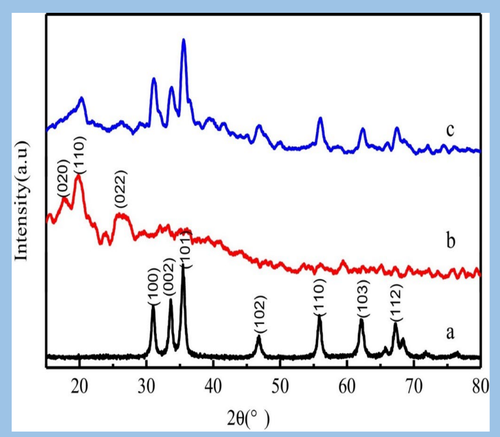

Fig. 3 – XRD patterns of ZnO (a), PVDF (b) and PVDF/ZnO hybrid membranes

SENSOR SURFACE MODIFICATION

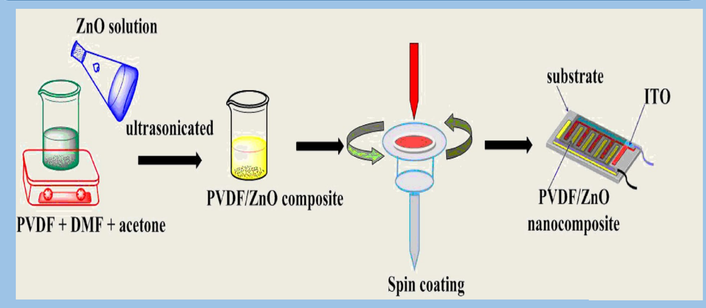

Fig 4. - The aim of the project is to investigate a resistive gas sensor composed of PVDF polymer matrix and ZnO nanoparticles for realizing high performance at room temperature. This will be successfully prepared by hydrothermal method and fabricated by spin-coating method.

NEED FOR POLYVINYLIDENE FLUORIDE

POLYVINYLIDENE FLUORIDE
(cause the surface morphology change of ZnO nanoparticles and formation of defects, enhancing the sensor)

Advantages

- **Highest tensile strength** of all processable fluorocarbons (5075-7250 psi)
- **Widely explored** among all other electroactive polymers
- High heat resistance (**248 °F**)

Disadvantages

- Naturally hydrophobic
- Poor resistance to **fuming acids**

BUILDING GAS SENSING CHAMBER

Fig. 5 - This customized ACB27 has two inlet valves for gas feeds, three vacuum USB feedthroughs for an array of sensors, and a UKAS-calibrated 70mm digital vacuum gauge for super accurate measuring while testing.

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