FABRICATION OF NANOPOROUS PLATINUM FILMS WITH DEALLOYING METHOD FOR HYDROGEN SENSOR APPLICATION

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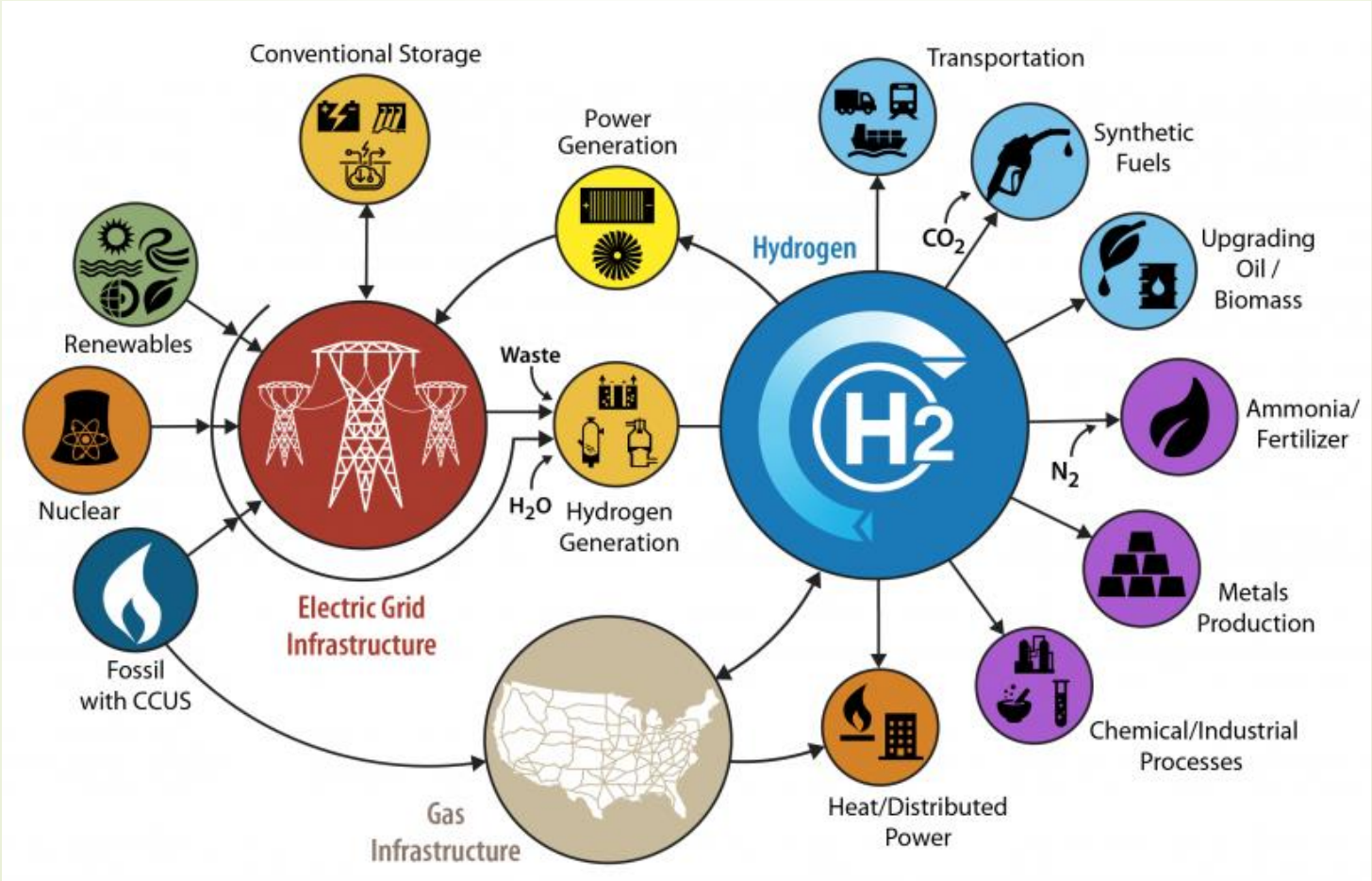
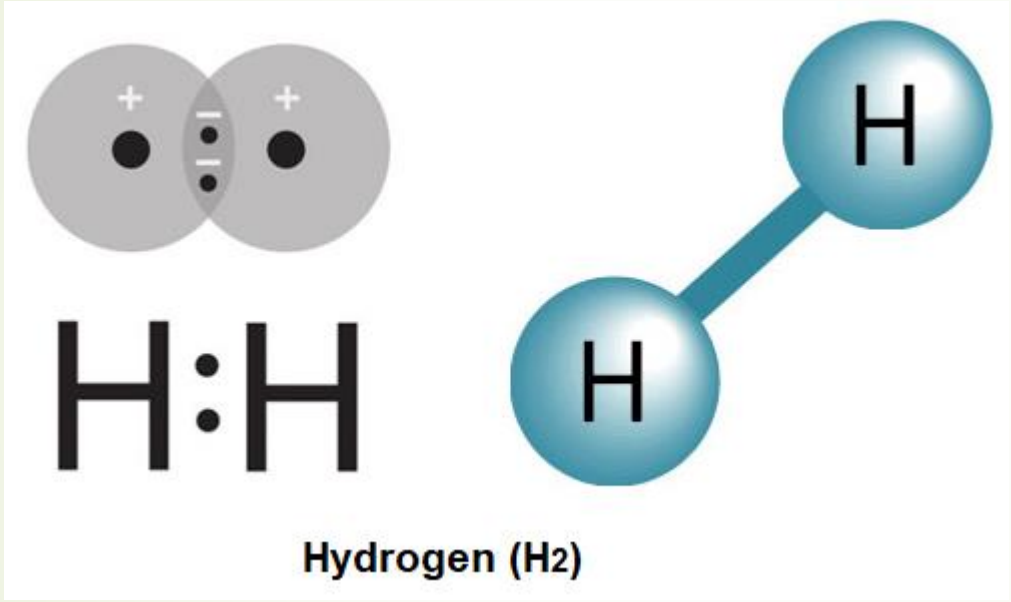
1. INTRODUCTION

Why do we need hydrogen?





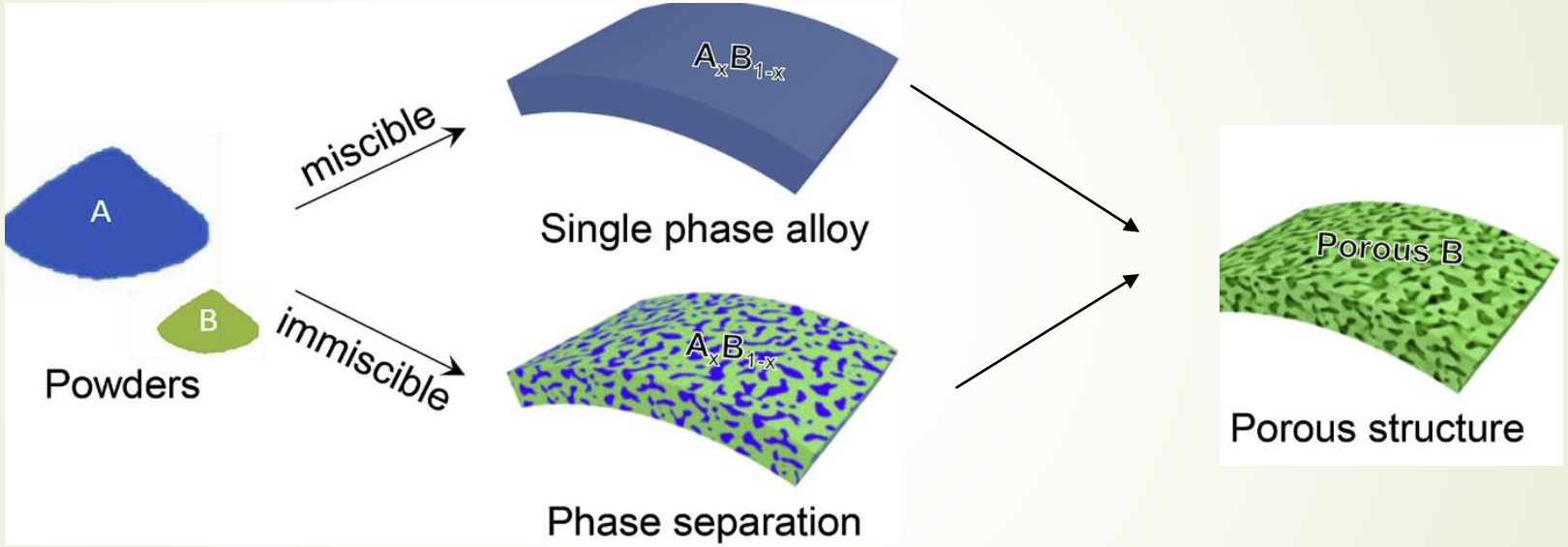
Hydrogen gas is

- colorless,
- odorless,
- tasteless and
- cannot be detected by the human senses

Where are metal and metal alloy nanomaterials used?

SENSORS

Dealloying, which is one of the nanoporous material production methods.



2. MATERIALS AND METHODS

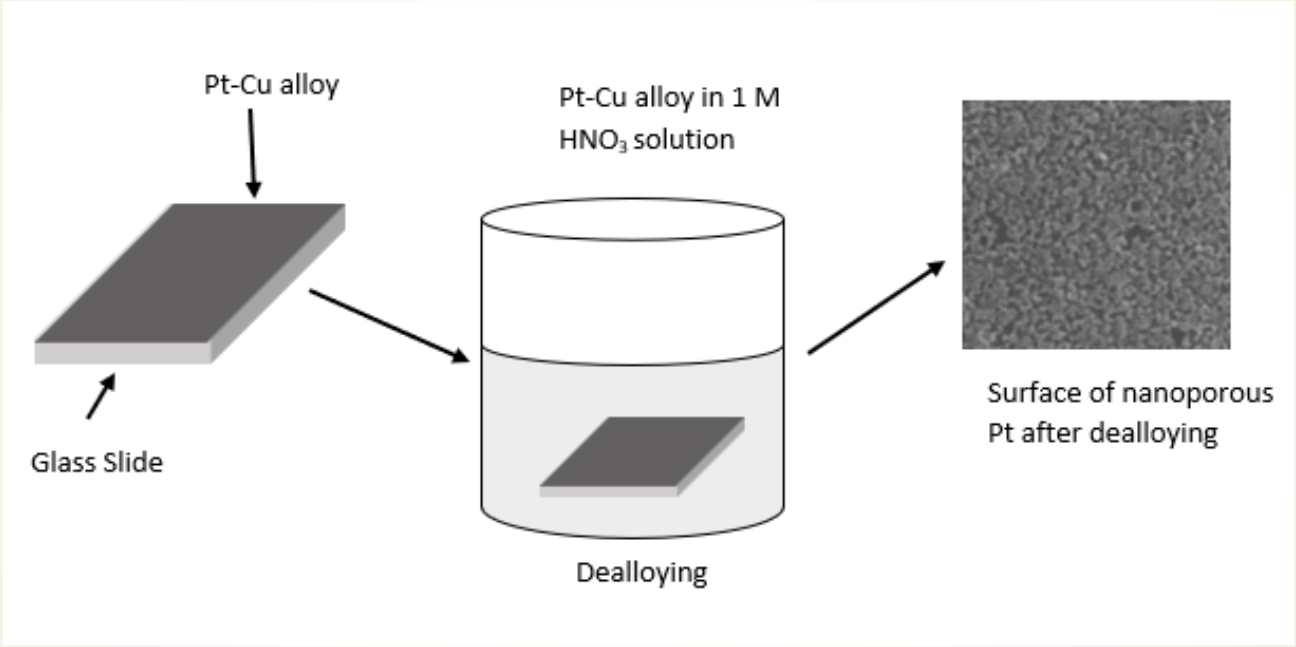


Fig 1: A Schematic Description Nanoporous Pt With Dealloying Method

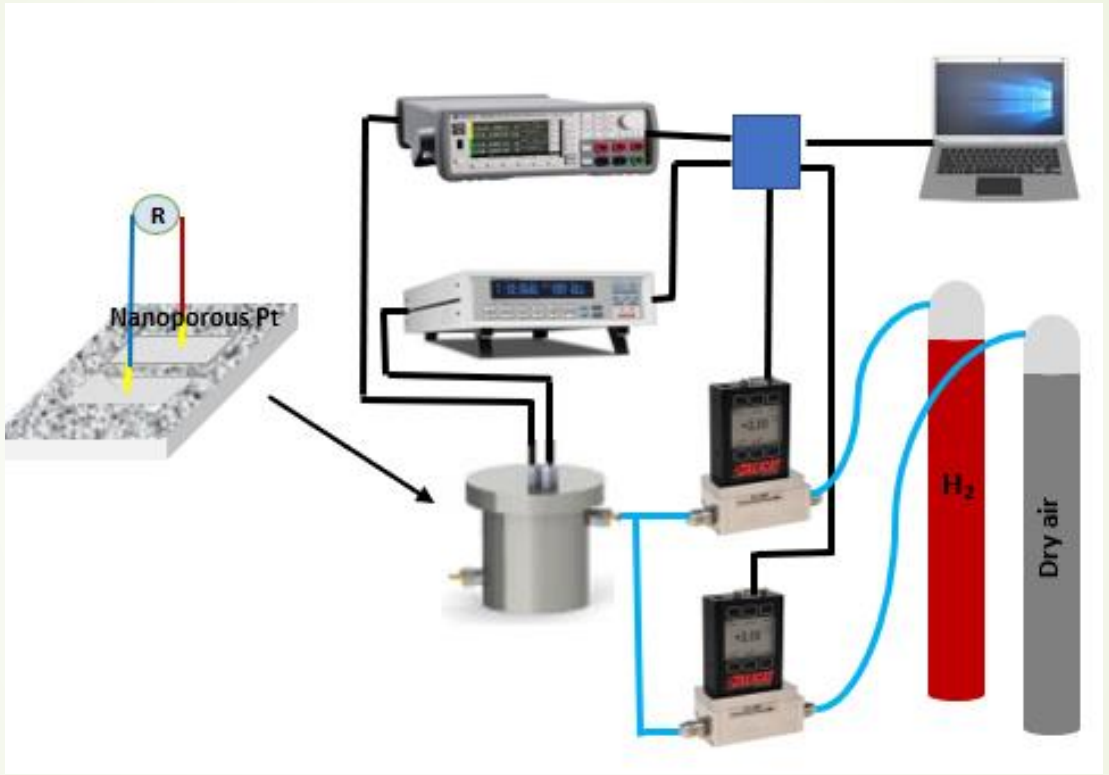


Fig. 2. A schematic description for nanoporous Pt sensor device and gas measurements system.

3. RESULTS

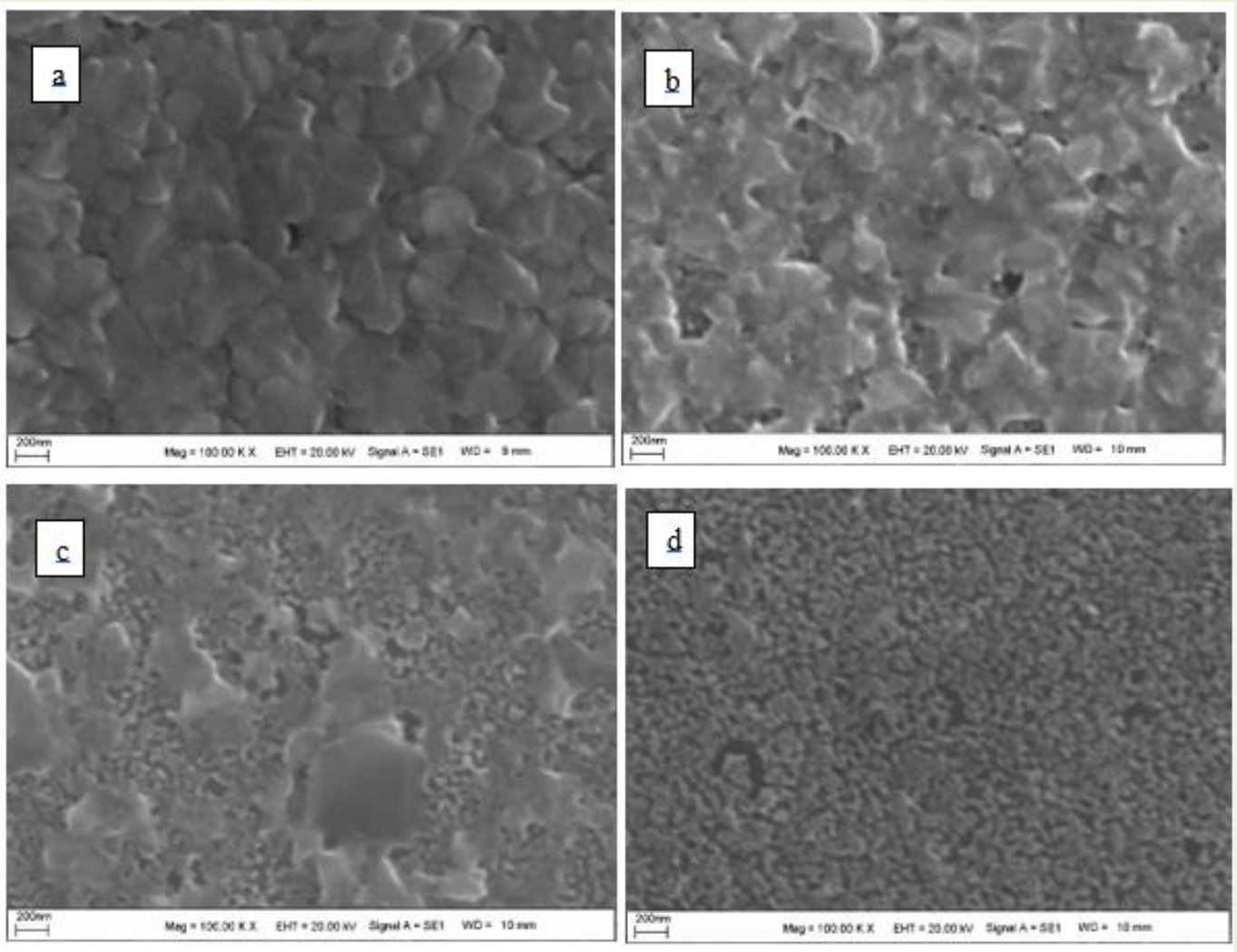


Figure 3: SEM images of Pt-Cu alloys dealloyed in 1 M nitric acid solution at different times (a: no dealloying, b: 15 min, c: 30 min, d: 1 hour)

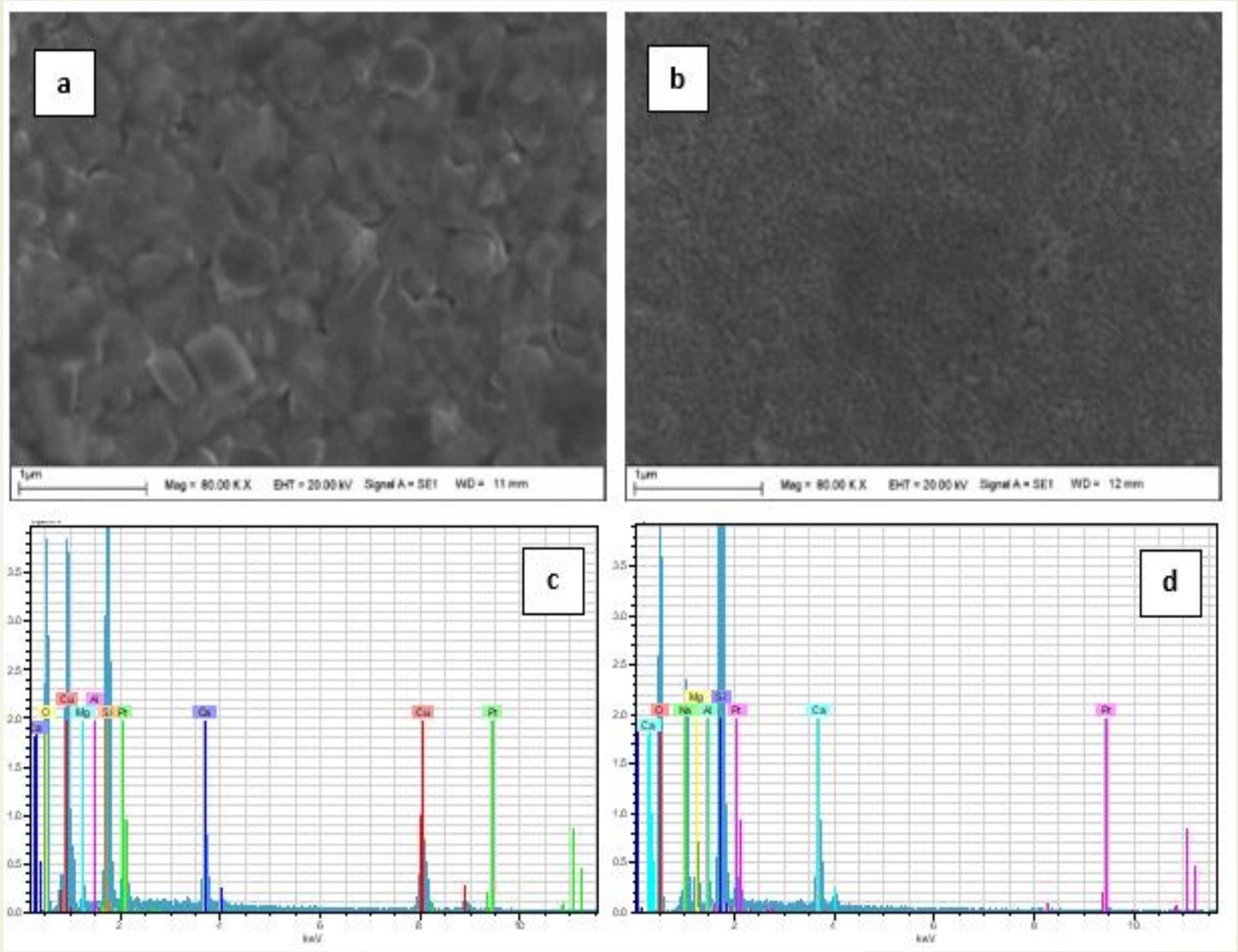


Figure 4. **(a)** SEM image of Pt-Cu alloys before dealloying; **(b)** SEM image of Pt-Cu alloys after dealloying in 1 M HNO_3 at 5 hours; **(c)** shows the peaks of the elements in the Pt-Cu alloy before dealloying; **(d)** shows the element peaks of nanoporous Pt dealloyed in 1 M HNO3 solution for 5 hours.

$$Sensitivity\ (S\%) = \frac{\Delta R}{R_H} x100 = \frac{R_0 - R_H}{R_H} x100$$

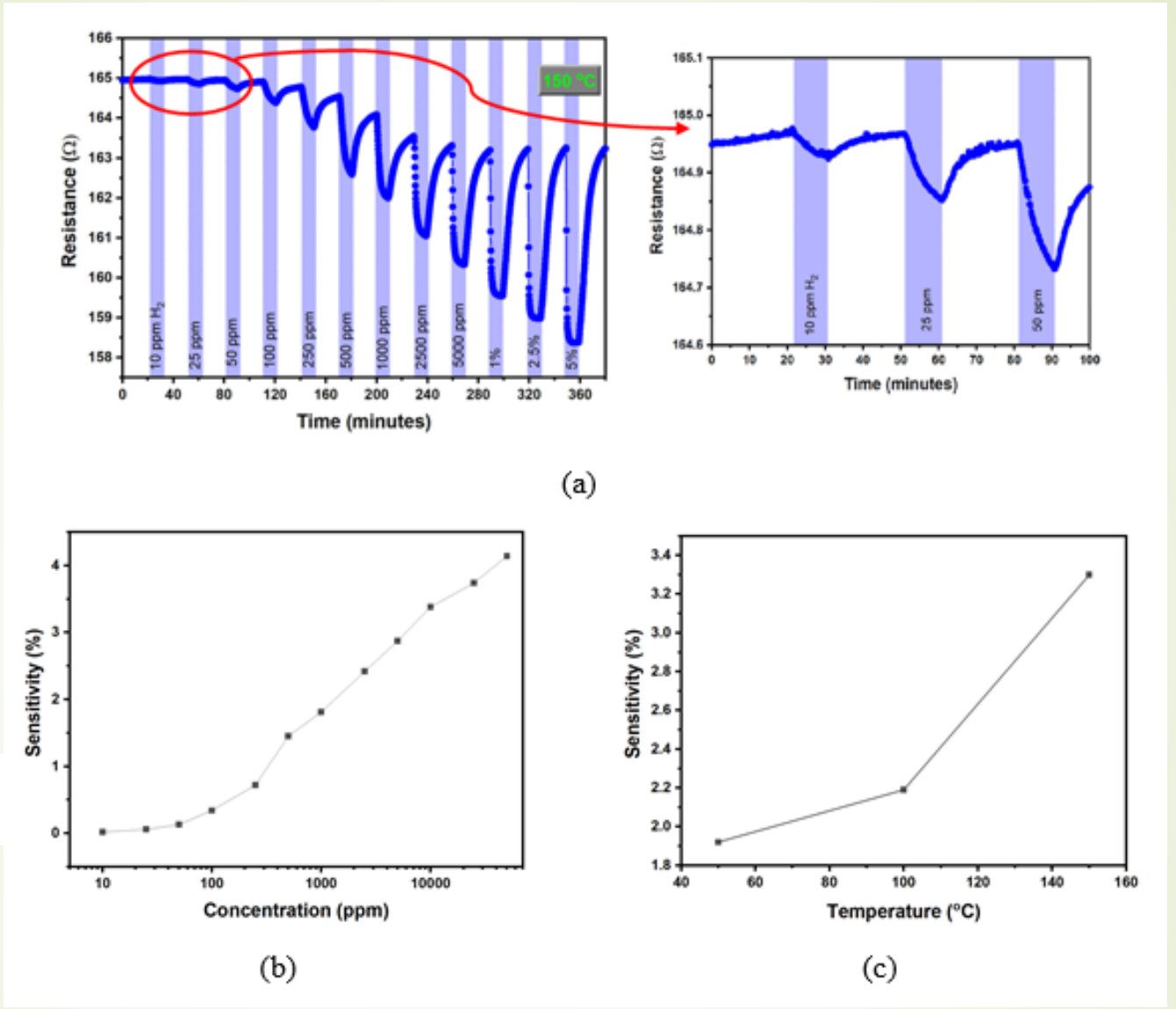
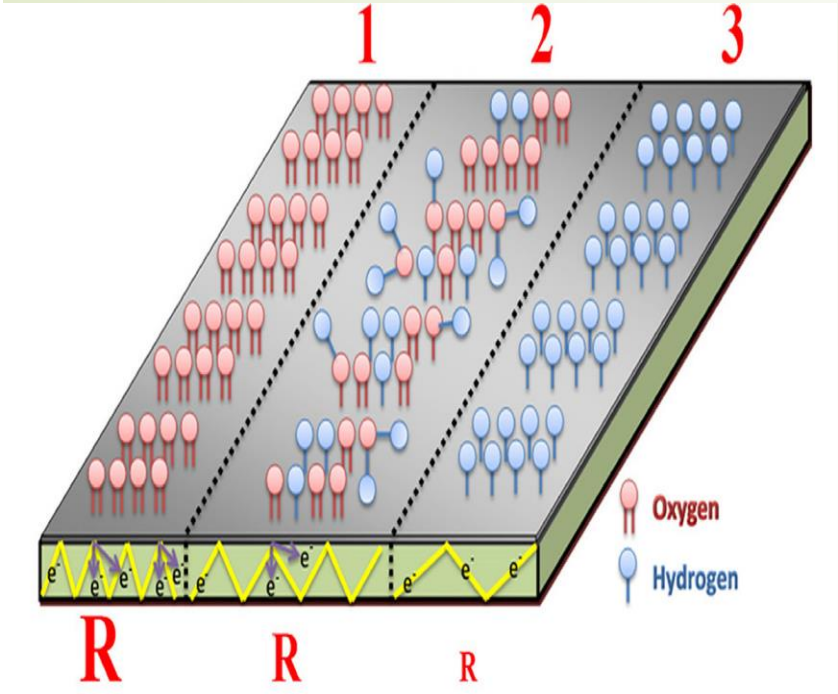


Figure 5. The resistance versus time graph (a) and sensitivity as a function of concetration chart (b) of nanoporous Pt film exposed to wide hydrogen concentration (10ppm – 5%) at the temperature of 150 °C. (c) The sensitivity versus temperature curve of nanoporous Pt exposed to 1% hydrogen.

Hydrogen Detection mechanism



$$Pt + \frac{1}{2}O_2 \rightarrow Pt\text{–}O$$

$$Pt\text{–}O + \frac{3}{2}H_2 \rightarrow Pt\text{–}H + H_2O$$

Under dry air condition, the surface of Pt is with adsorbed oxygen. (1)

While the hydrogen exposed to Pt surfaces, hydrogen atoms start to displace oxygen on the surface. (2)

If Hydrogen concentration is high enough, the surface is fully covered Hydrogen atoms.(3)

The resistance of Pt decreases, when exposed hydrogen could be related to decreasing the number of the surface charge carrier scattering.

This process is reversible.

THANK YOU FOR YOUR ATTENTION

Acknowledgements

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