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1. Abstract & Object

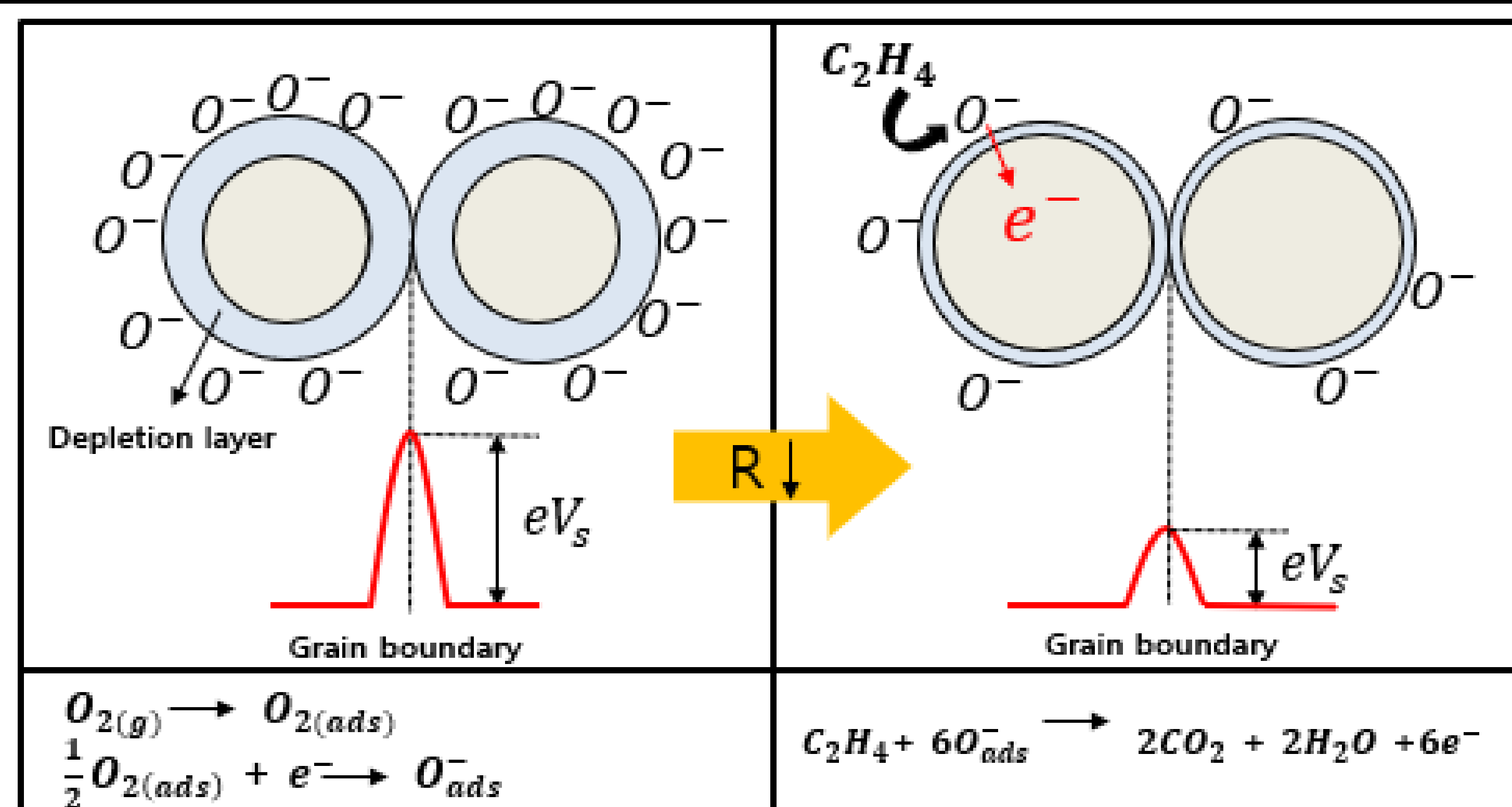
❖ Background of Research

- The hydrocarbon gas is generated if the insulation oil used in the transformer is overheated. In turn, It can lead to accidents by causing large defects of transformer. So that the detection of gas is important to prevent major accidents.
- There are various ways to measure the gas in the insulating oil of the transformer. But they have some problems. The sensitivity of the sensor is not enough to detect low concentration of gas, and it is impossible to detect gas in real time.

❖ Property of Gas sensor based on 3D nano-structured SnO_2

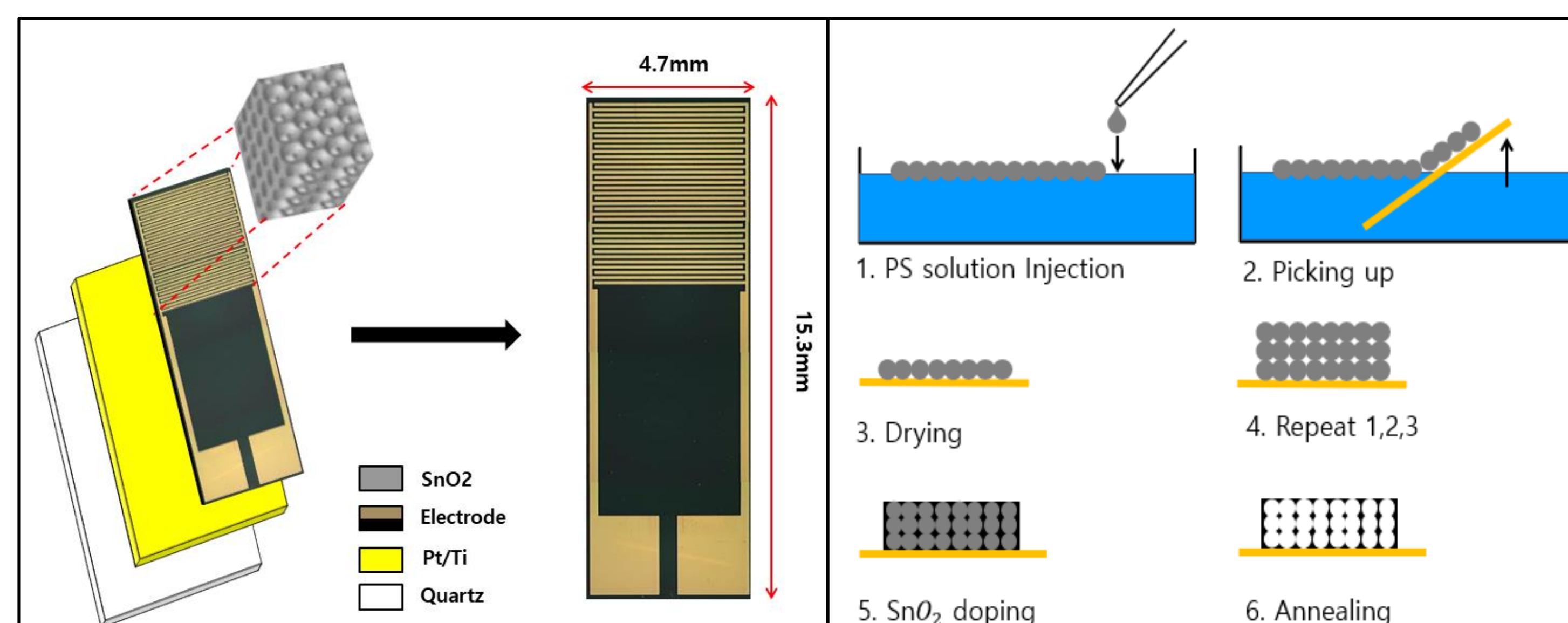
- High sensitivity
- Real time gas detecting system

2. Gas sensing mechanism



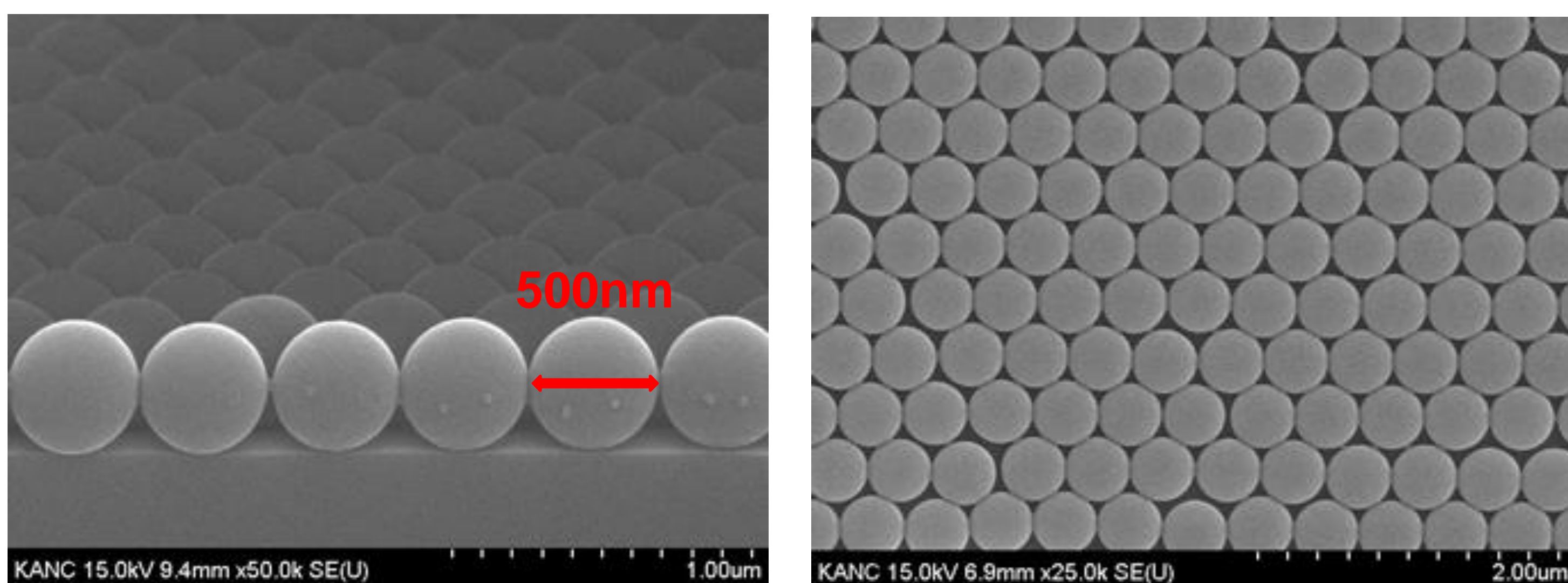
- If the SnO_2 is heated at a temperature about 150°C , The oxygen is adsorbed on the surface of the SnO_2 , and it traps electrons. It makes negatively charged chemisorbed oxygen such as O^- . Therefore it makes electron depletion layer.
- When C_2H_4 reacts with SnO_2 , it is oxidized with adsorbed oxygen on the surface of SnO_2 so that the electrons in oxygen go into the SnO_2 . Therefore, the resistance will be decreased. By measuring this resistance variation, It is possible to detect C_2H_4 .

3. The structure of sensor and making procedure



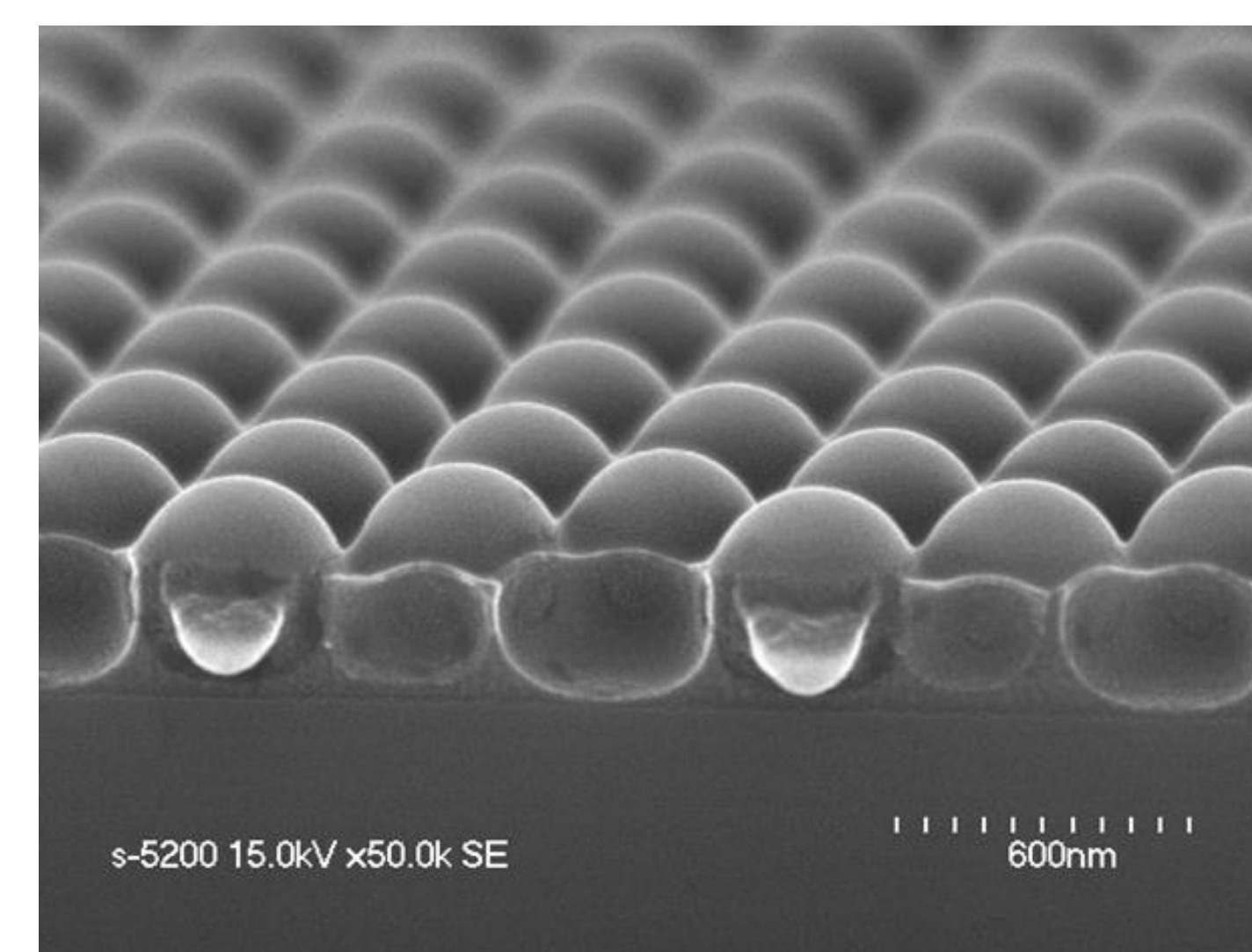
- Electrode : Pt / Ti (100nm / 10nm)
- Sensing part : 3D nano-structure of SnO_2

4. Experiment Results

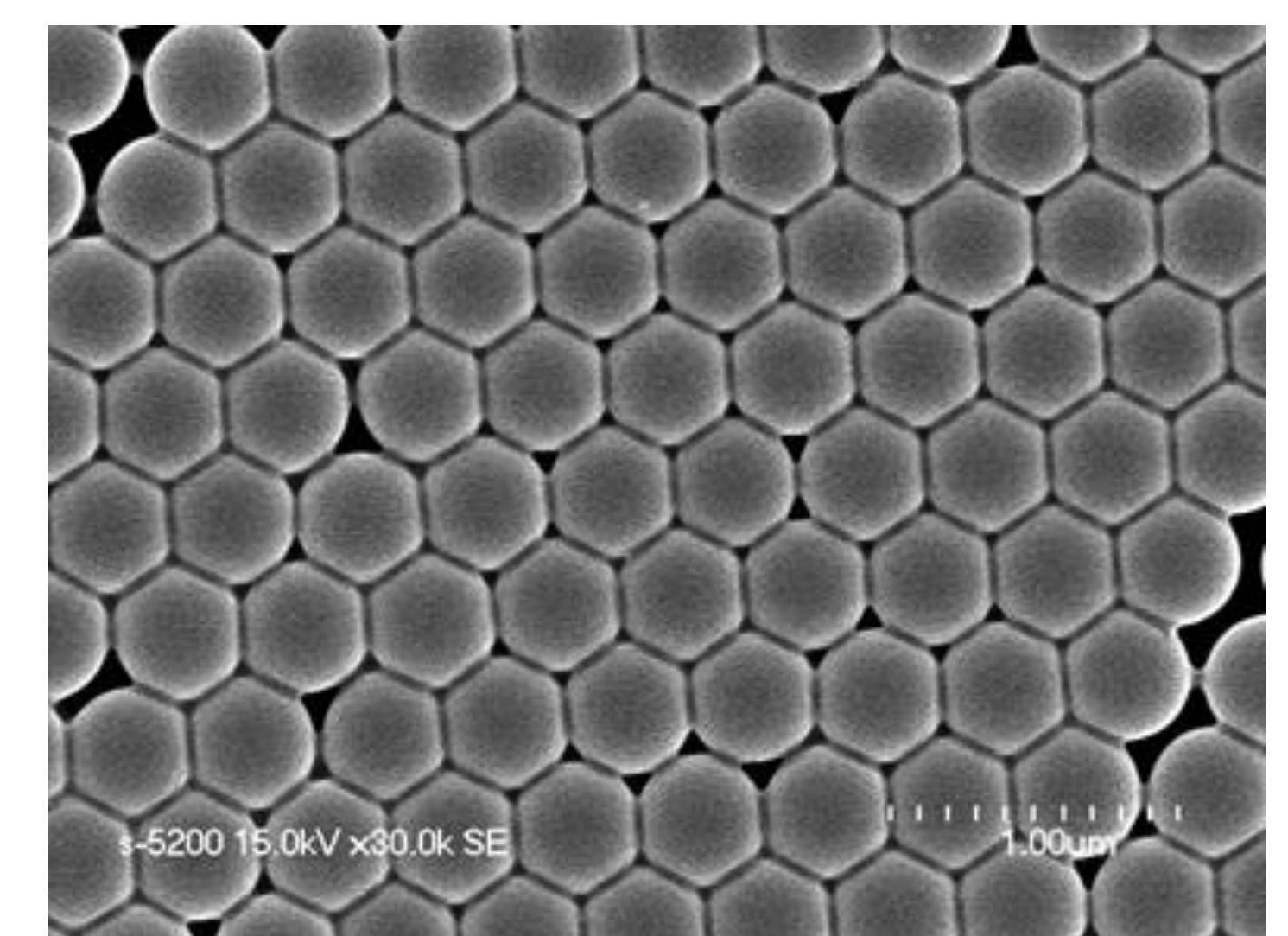
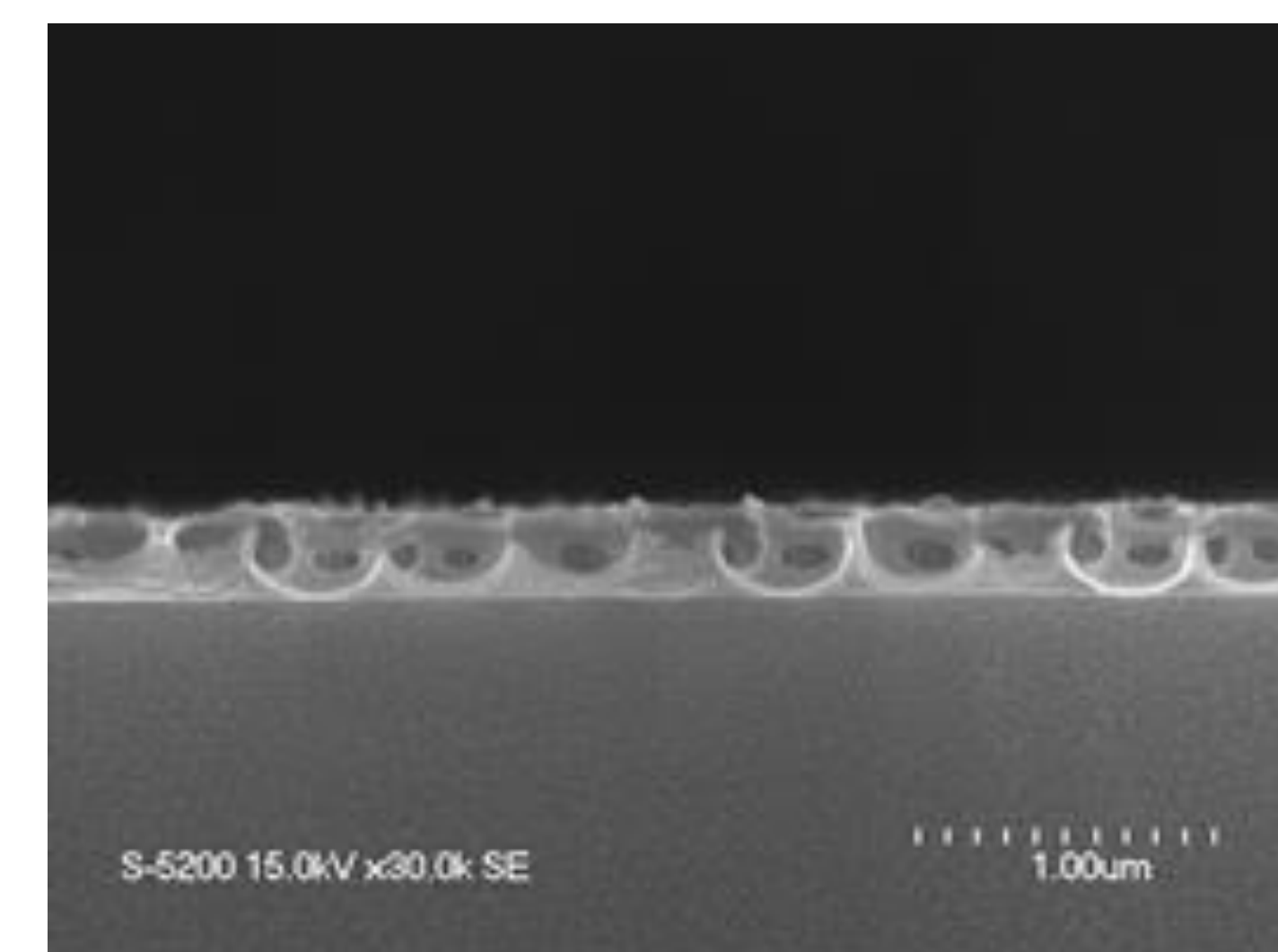


❖ Cross view of Polystyrene monolayer ❖ Top view of Polystyrene monolayer

- The Polystyrenes are arranged uniformly on the wafer surface.

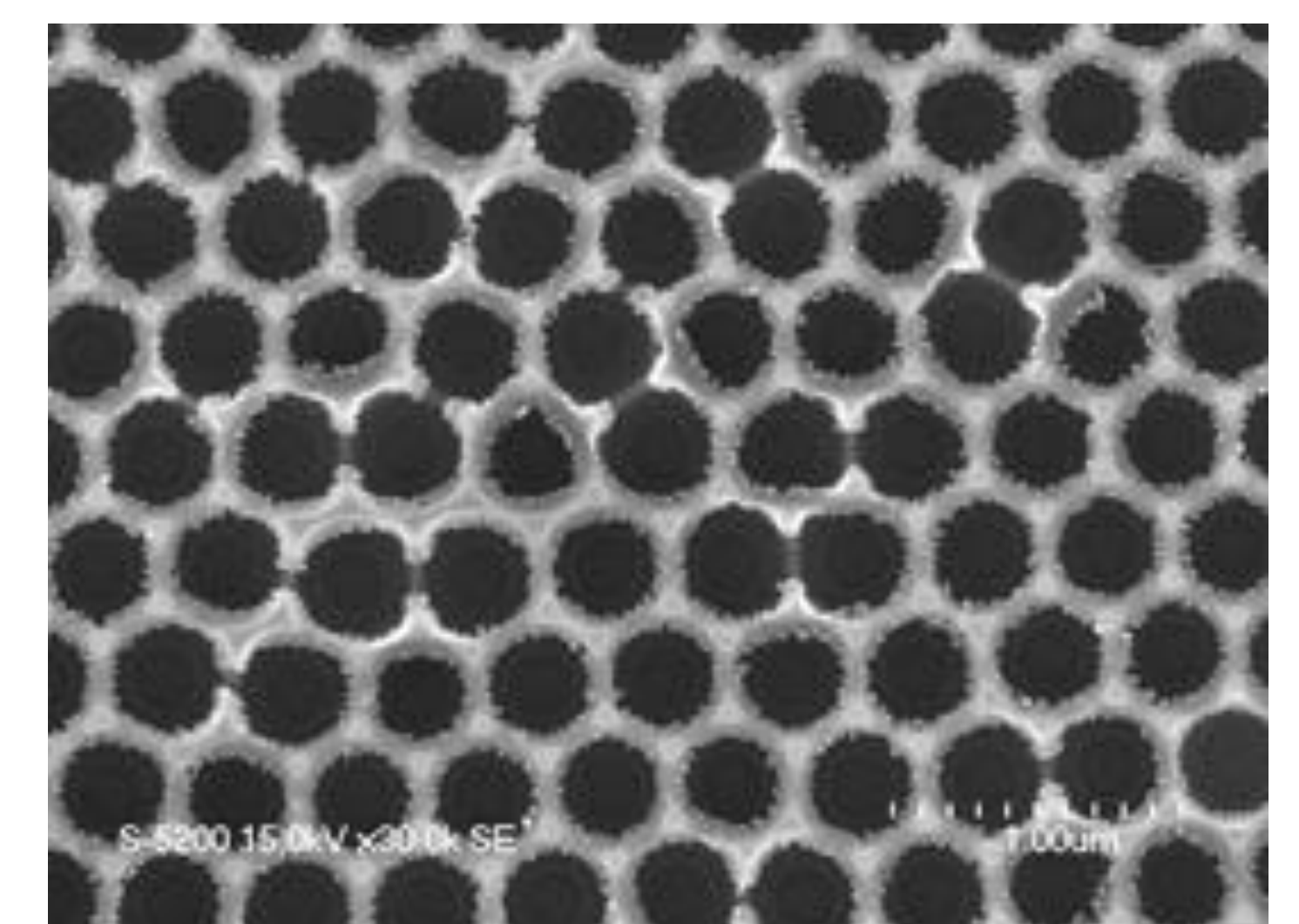
❖ Cross view of Polystyrene monolayer after $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$ solution doping

- $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$ solution is doped into the empty space of the polystyrene monolayer.

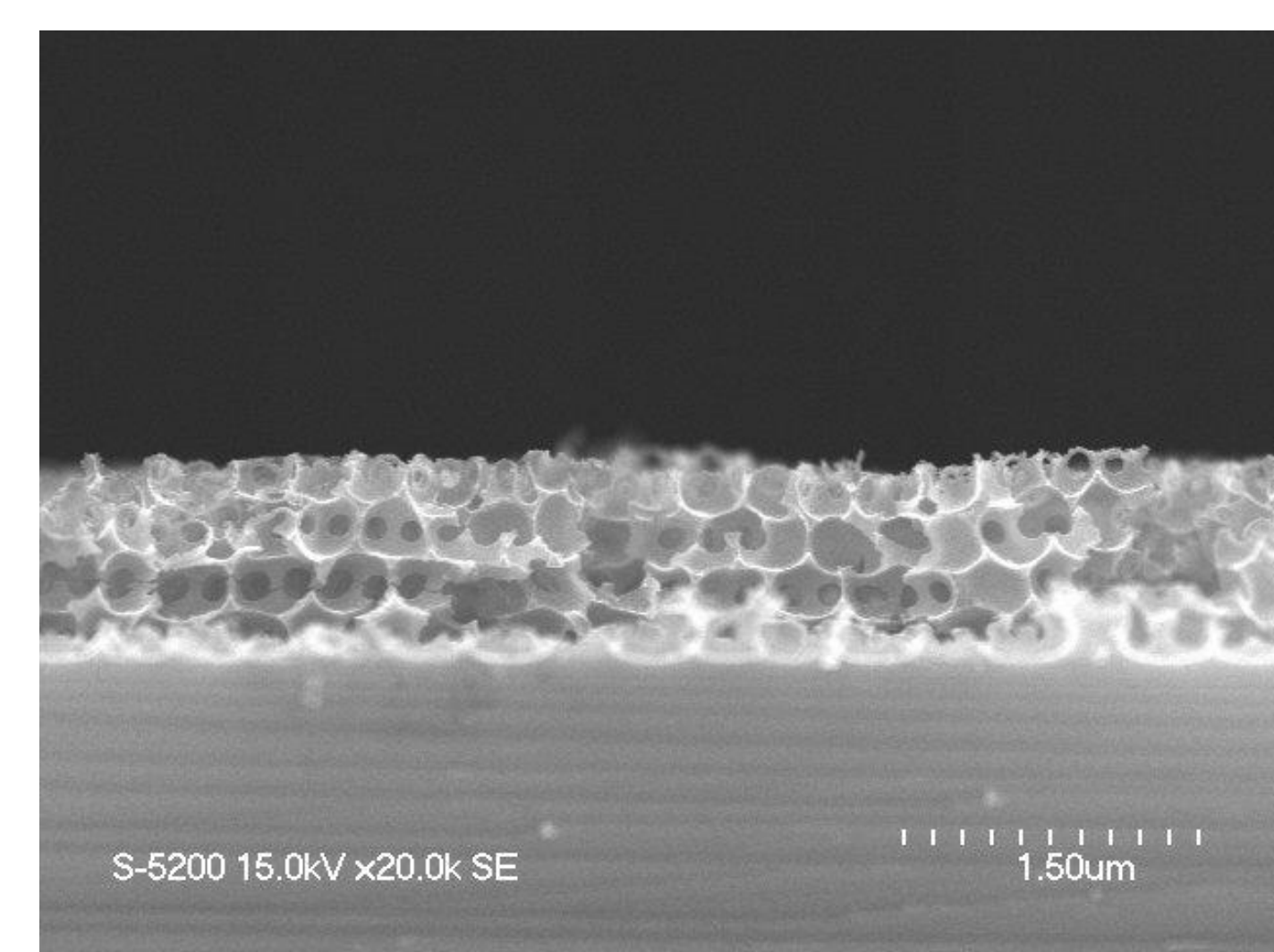
❖ Top view of Polystyrene monolayer after $\text{SnCl}_4 \cdot 5\text{H}_2\text{O}$ solution doping.

❖ Cross view of structure after removing Polystyrene by annealing

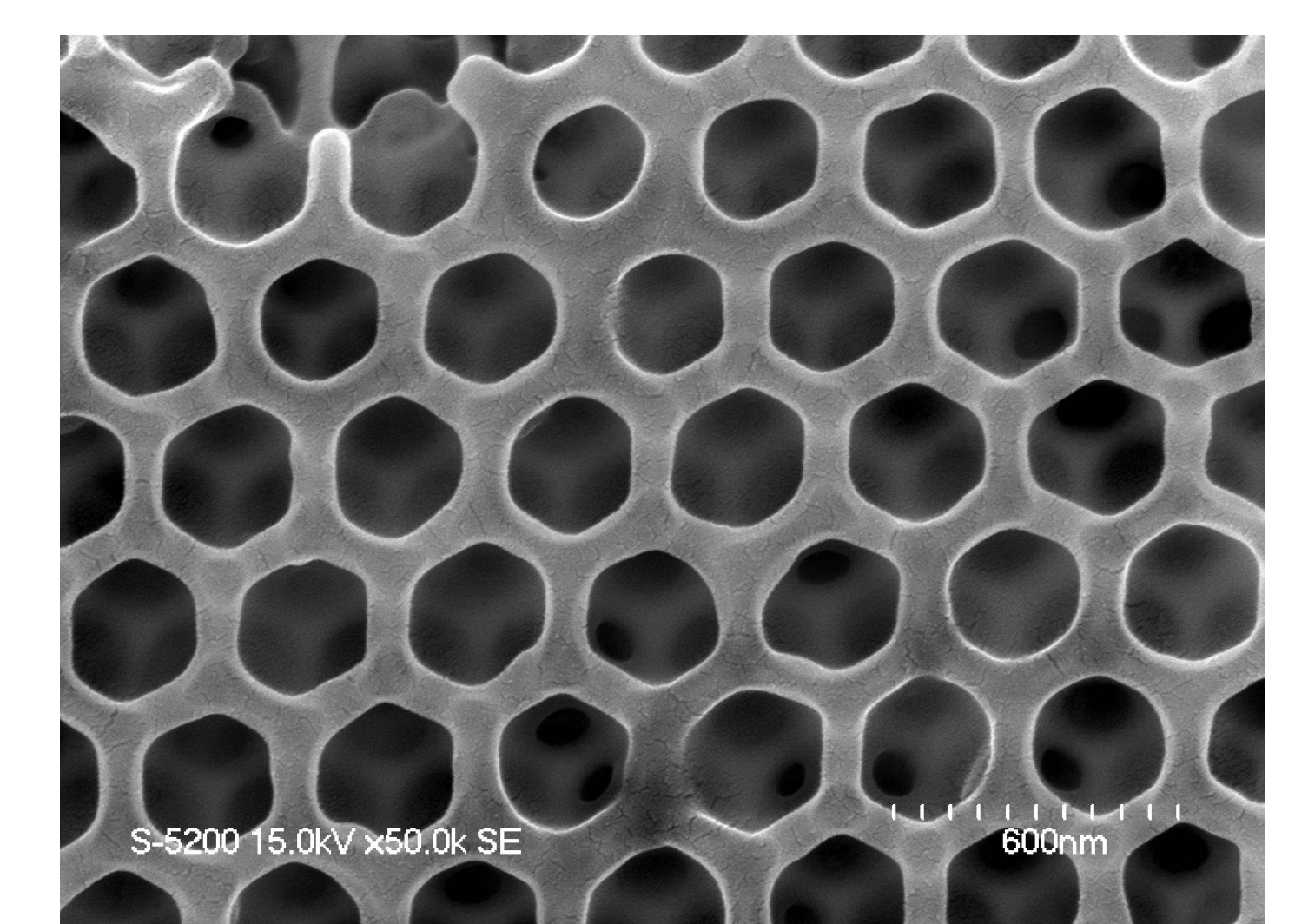
- Polystyrenes are removed by annealing at 500°C , and SnCl_4 becomes SnO_2 .



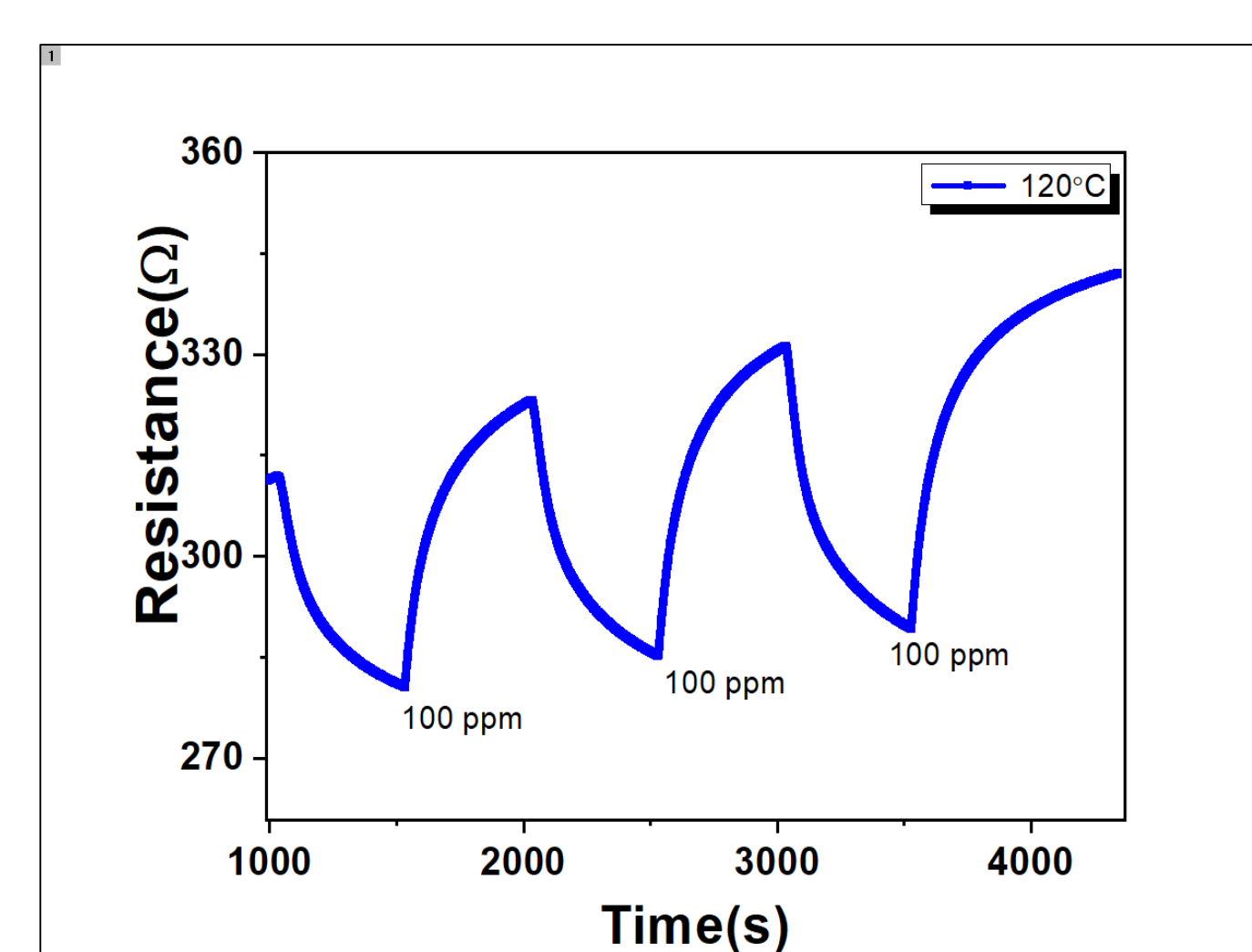
❖ Top view of structure after removing Polystyrene by annealing

❖ 3D nano-structure based on SnO_2

- High sensitivity due to large surface area
- High thermal stability

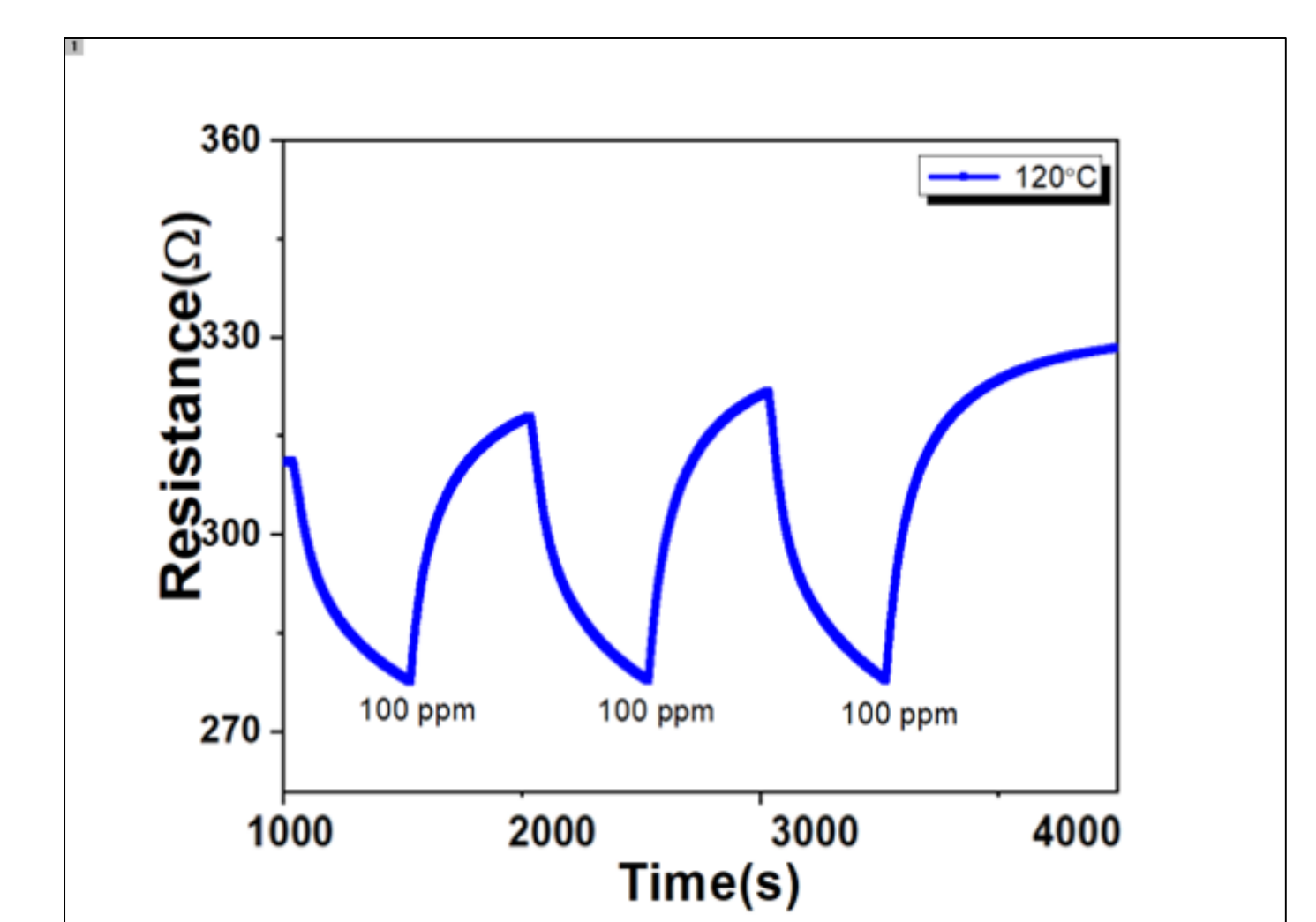


5. Result Of sensor response



❖ Before base-line correction

- Sensor works at 120°C
- Sensor has good repeatability
- Base-line correction is needed because of base-line shifting of resistance



❖ After base-line correction

6. Conclusions

❖ Conclusion

- In this study, we have developed the gas sensor that detect ethylene.
- Three dimensional nano structure has developed to increase the sensitivity of the ethylene gas sensor.
- Sensor works at 120°C and has good repeatability