Control of the response to water vapor of gas-sensitive zinc oxide nanostructures

Svetlana S. Nalimova[1*], Zamir V. Shomakhov[2], Vlada V. Miroshkina[1],
Cong D. Bui[1], Vyacheslav A. Moshnikov[1]
[1] Saint Petersburg Electrotechnical University "LETI" (*sskarpova@list.ru)
[2] Kabardino-Balkarian State University

PROBLEM

when the sensors are operating in an environment, water vapor can competitively adsorb on the surface of the metal oxide structure. The chemical adsorption of water molecules changes the baseline resistance of the metal oxide sensor, leading to a decrease in its sensitivity to the target gas.

TASK

- ✓ to find approaches to the synthesis of gas-sensitive zinc oxide layers that are resistant to the influence of water vapor;
- ✓ to study the influence of the seed layer type on the sensor properties of zinc oxide nanostructures produced by hydrothermal synthesis.

CHARACTERIZATION

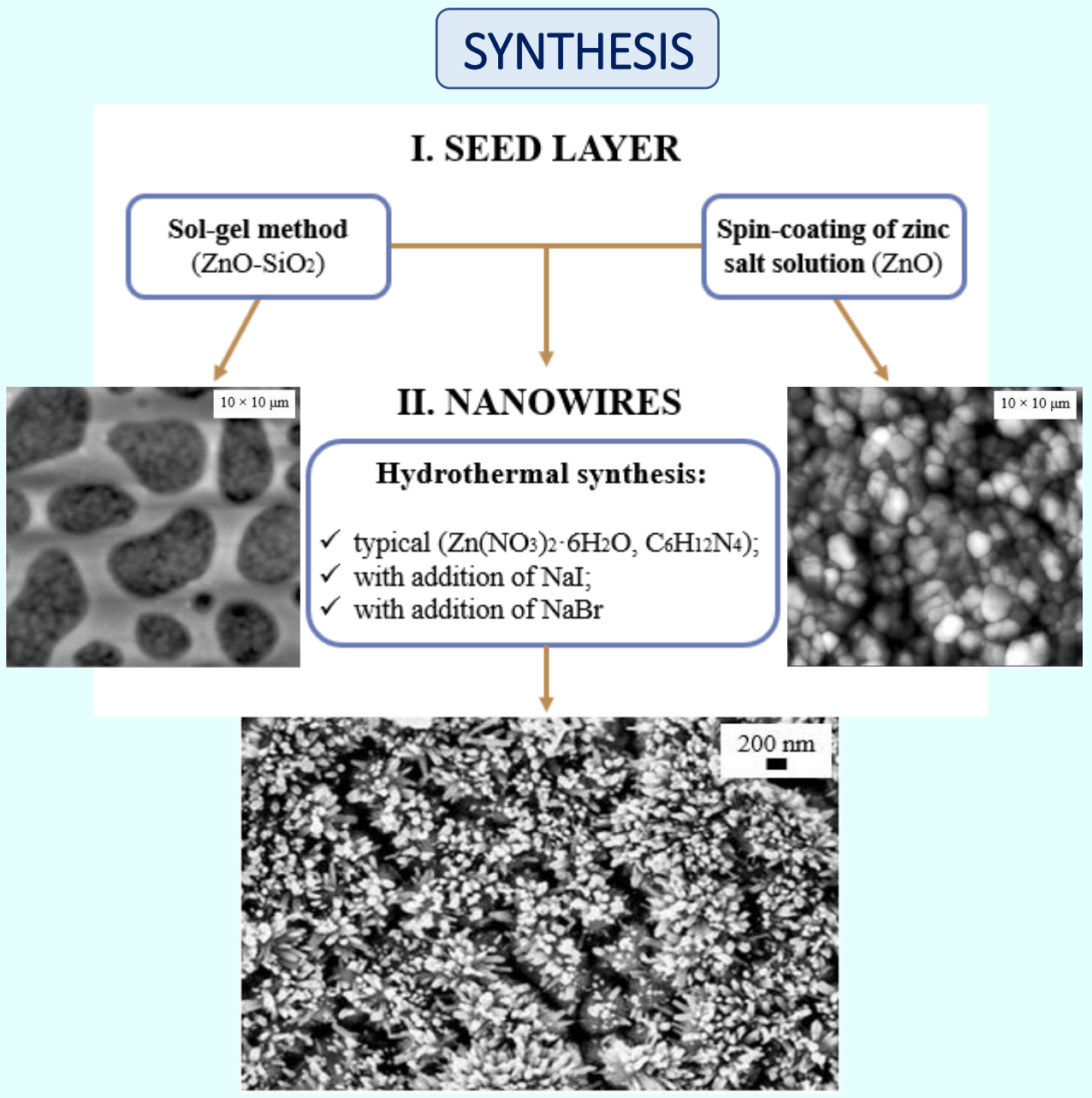
- ✓ SEM, AFM
- ✓ Gas sensing measurements:
  T=250°C, test gases: isopropanol (1000 ppm), water (74000 ppm),
  Response: $S = R_{air} / R_{gas}$

RESULTS

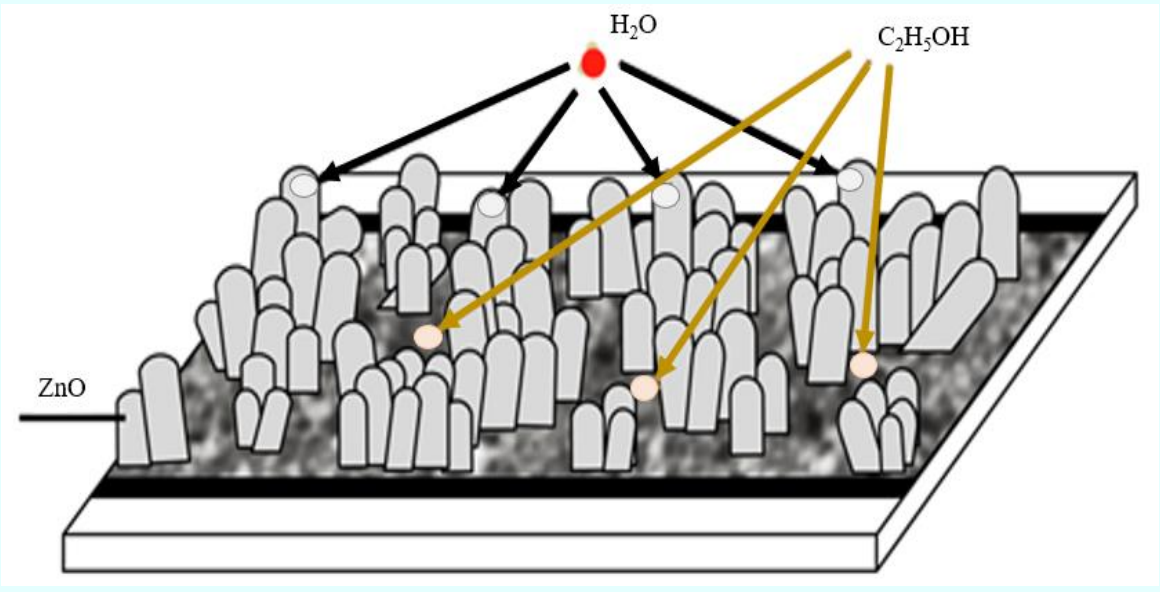
Sensor responses of samples formed on different types of seed layers to vapors of isopropyl alcohol and water

Seed layer	Nanowires type	$S(C_3H_7OH)$	$S(H_2O)$
$ZnO\text{-}SiO_2$ nanocompo-sites	ZnO(I)	1,58	1,84
	ZnO(Br)	1,67	2,17
ZnO nanoparticles	ZnO(I)	2,97	1,21
	ZnO(Br)	4,03	1,18

SYNTHESIS



THE MECHANISM OF THE INTERACTION BETWEEN THE SURFACE OF ZINC OXIDE NANOSTRUCTURES AND GAS MOLECULES



CONCLUSIONS

- ✓ In developed ZnO nanostructures grown on ZnO nanoparticles current flows through the seed layer.
- ✓ The predominant adsorption of water vapors onto zinc oxide nanowires does not affect the resistance of gas-sensitive layer.
- ✓ When isopropyl alcohol vapors appear, adsorption occurs on the surface sites of the seed layer, and interaction with negatively charged oxygen reduces the resistance of the gas sensing layer.