

Nanostructured (Sn,Ti,Nb)_xO₂ solid solution for gas sensing applications

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Abstract

Emerging nanotechnologies improved solid-state sensors capabilities and enabled the use of semiconducting metal oxides-based gas sensors for new and increasingly demanding applications. However, further research on sensing materials is still needed to increase the sensitivity, selectivity and stability of such sensors.

Nanostructured metal-oxide solid solutions represent a valuable approach for tuning the sensing properties by modifying their composition, morphology, and structure. For example, tin and titanium dioxides (SnO₂ and TiO₂) would easily form solid solutions since they can exhibit a rutile type structure where octahedrally coordinated Ti⁴⁺ and Sn⁴⁺ have similar ionic radii. Such solid solution combines the positive qualities of the singles oxides, e.g. high sensitivity towards reducing gases and low influence by humidity.¹

Such solid solution was empowered by addition of Nb, which – according to earlier studies on titania films – was expected to inhibit grain growth at high temperature, to reduce the film resistance³ and to impact the sensor selectivity and sensitivity. Nanostructured (Sn,Ti,Nb)_xO₂ powders were synthesized through co-precipitation by keeping the Sn/Ti proportion constant at the optimal value for sensing performance, while changing Nb concentrations and calcination temperature. Powder compositions, structures and morphologies were investigated by different techniques. The electrical characterization of the sensors based on nanostructured (Sn,Ti,Nb)_xO₂ showed that the niobium concentration and the heating treatment of powders are fundamental parameters to optimise the sensing characteristics of a sensor.

¹Carotta, et al., *Sensors and Actuators B* **139** (2009) 329–339

²Ferroni, et al. *Sensors and Actuators B: Chemical* **68.1-3** (2000) 140-145

Short Biography: {Max words limit 100}

Elena Spagnoli obtained her M.Sc. degree in Chemistry (Magna cum Laude) at the University of Ferrara, in 2019. She is currently a Ph.D. student in Physics at the University of Ferrara, working on the synthesis of nanostructured semiconductors for the development of chemiresistive gas sensors.

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