Room temperature CO_2 detection by metal oxides based nanosensors

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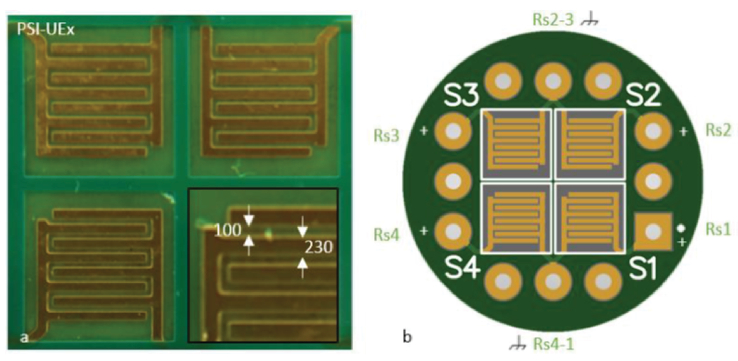
Carbon dioxide is considered a greenhouse gas and is the main cause of global warming. CO_2 emissions are increasing each year (420 ppm this year). Therefore, it is important to be able to detect these CO_2 levels with sensors that can work at room temperature (RT).

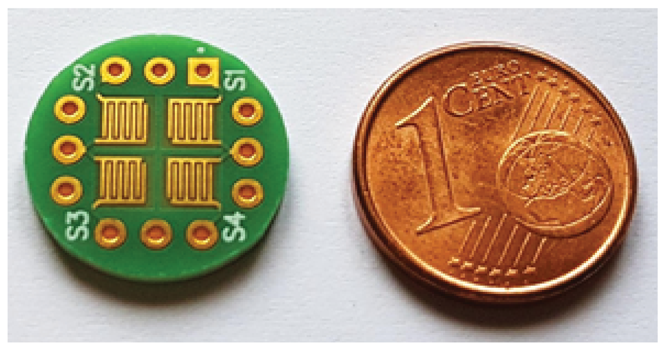
An array of 4 sensors (Fe_2O_3, SnO_2, ZnO and CuO) has been tested for the detection of CO_2 at RT in dry and humid (50 %HR) air. Low-cost sensors were prepared by the drop-casting technique from nanoparticle dispersions. Photoactivation of the sensors with UV-LED allows detection of CO_2 at ambient temperature. Humidity improves the response of all sensors to CO_2 and concentrations as low as 100 ppm CO_2 can be detected.

Materials

Sensor	Material	NP diameter (nm)
S1	SnO_2	100
S2	ZnO	50
S3	CuO	50
S4	Fe_2O_3	50

Dispersions of nanoparticles in deionized water (2.5 mg/ml). Sonication before drop-casting.

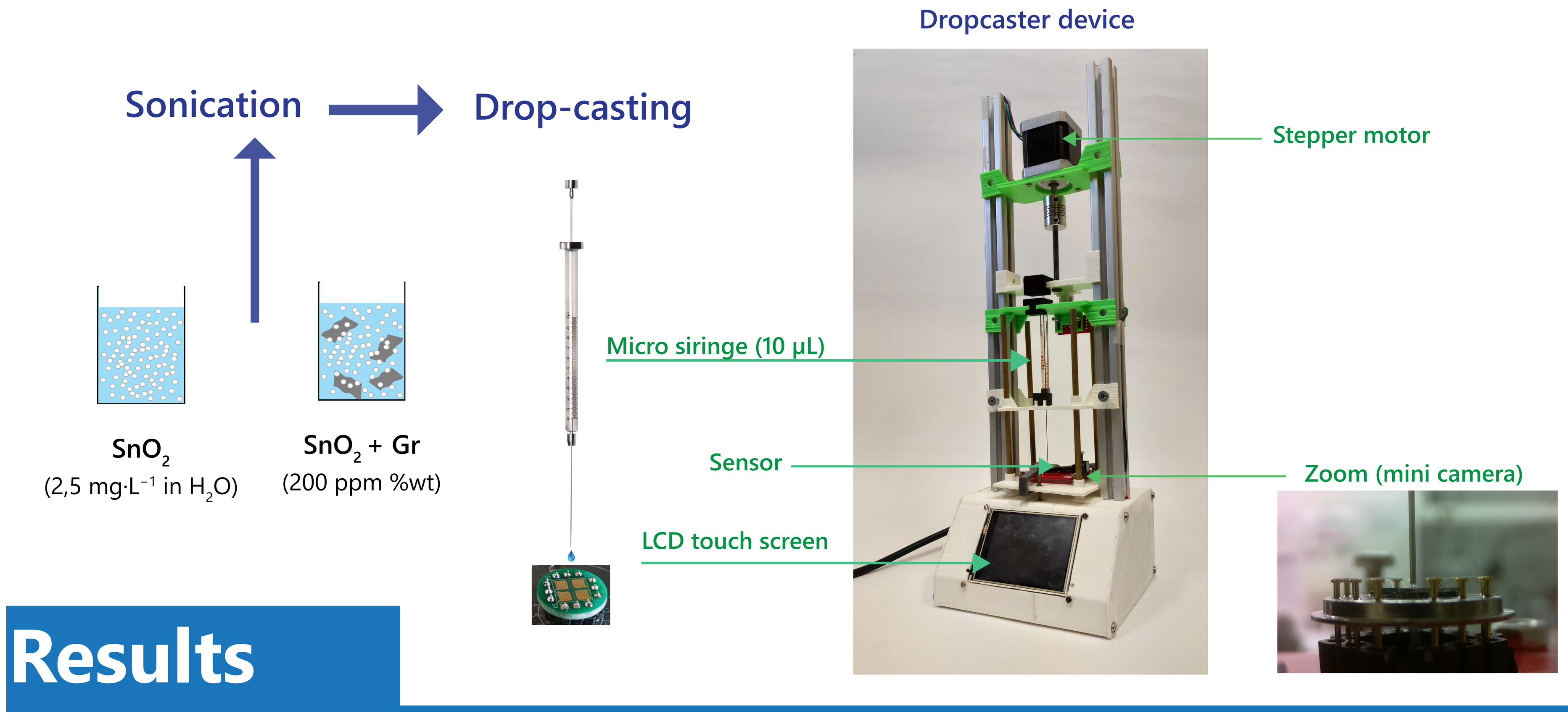




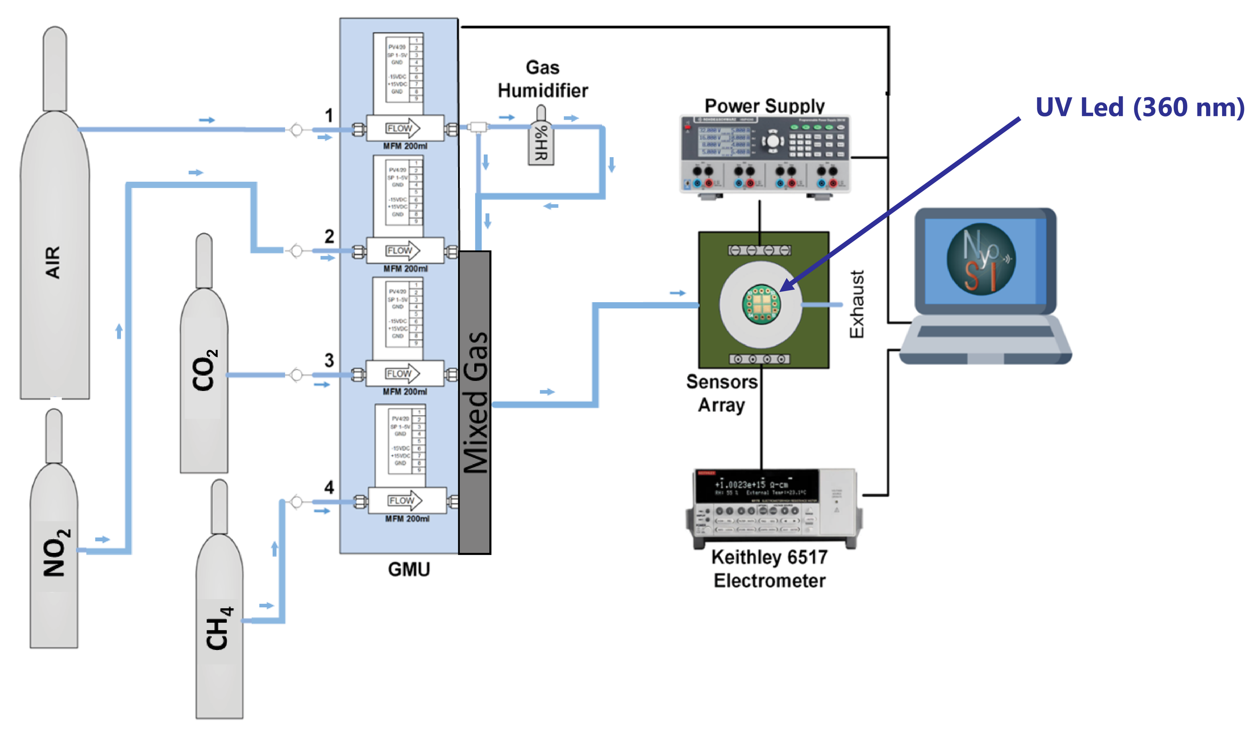
Multisensor platform: FR-4 substrate (Eurocircuits NV, Belgium). FR-4 (diameter: 15.24 mm, thickness: 0.3 mm) is a flame resistance, almost zero water absorption and wide operating temperature range (from 50 ºC to 115 ºC).

Methods

Drop-casting

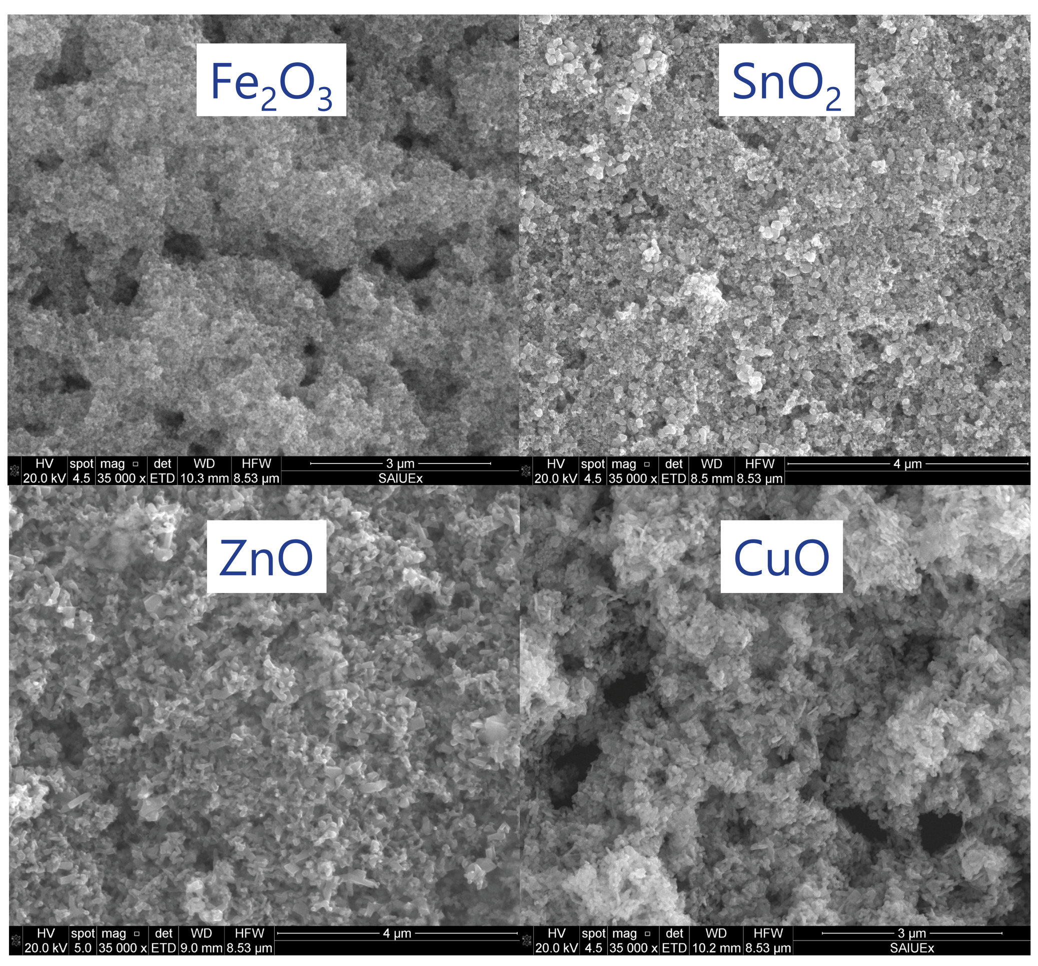


Measurement setup

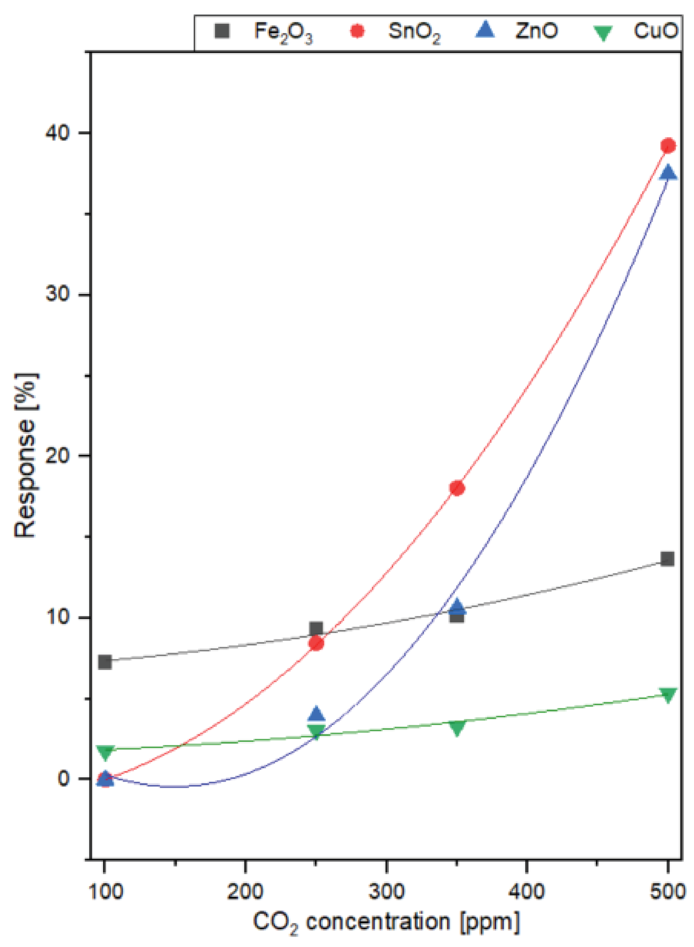


Results

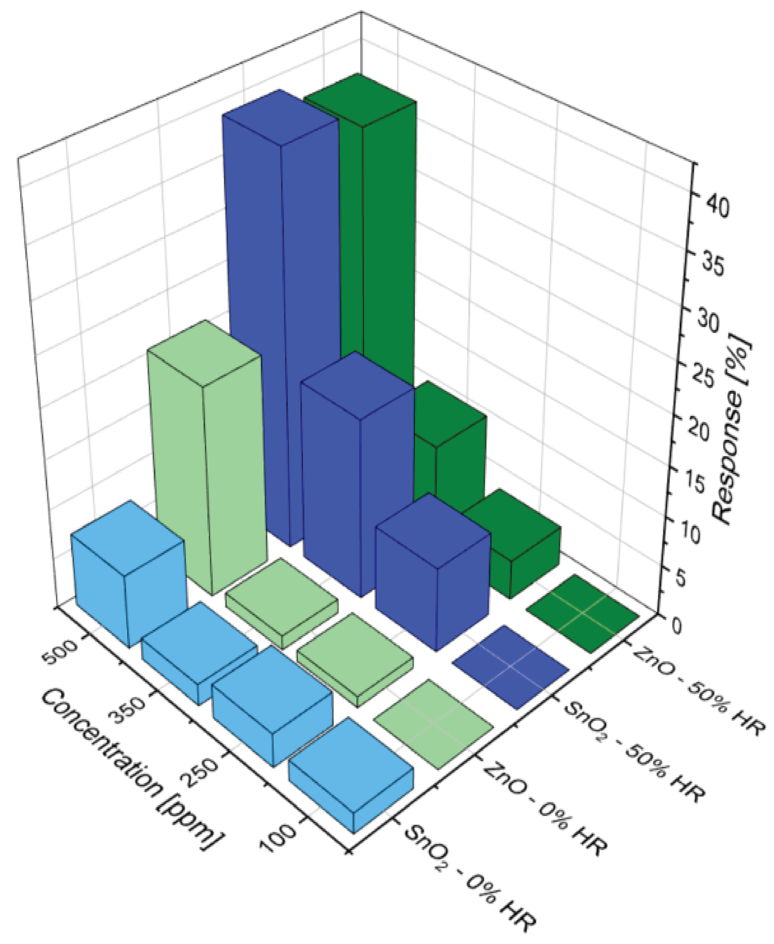
SEM images of different metal oxides



Responses of different sensors at 50 % RH



Responses of SnO_2 and ZnO sensors to CO_2 at 0% and 50 % RH



Conclusions

- Low CO_2 concentrations detection **(100 ppm)**. SnO_2 and **ZnO** sensors respond better to different CO_2 concentrations. On the other hand, the response of Fe_2O_3 and CuO sensors is lower and it is practically the same for different CO_2 concentrations.
- **UV LED**: speed up gas desorption from sensitive layer.
- **Humidity** effect: increase response.
- **Cheap** fabrication method.

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