Status of R&D on RH FOS @ PH/DT

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- Motivations
- PH/DT test set-up
- Phase I: tip-coated (NFFP) oxide sensors
- Phase II: FBG polyimide sensors
- Phase III: new collaboration agreement

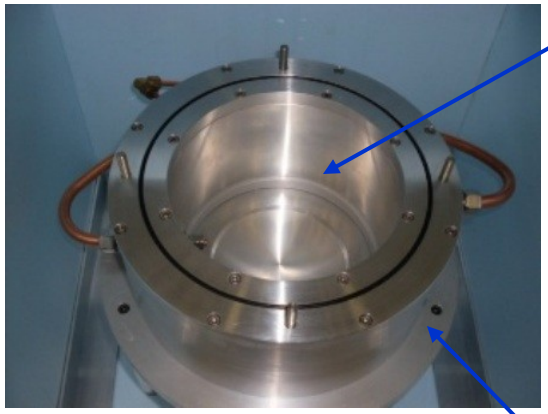
Motivations

- Almost all **miniaturized** humidity sensors presently available on the market are electronic sensors (mainly capacitive-based, followed by resistive-based).
- Despite all efforts, these sensors still fail to provide a complete set of favourable characteristics, e.g., good linearity, high sensitivity, low uncertainty, low hysteresis and rapid response time.
- For an application in HEP detectors, one should add to this the sensitivity to **electro-magnetic noise** pick-up, the suitability for **multi-point distributed measurements** and the resistance to **ionizing radiations**.

Nowadays – although important requirements on environmental control exist, in particular for Trackers – there is no miniaturized humidity sensor on the market well suited for HEP detector applications

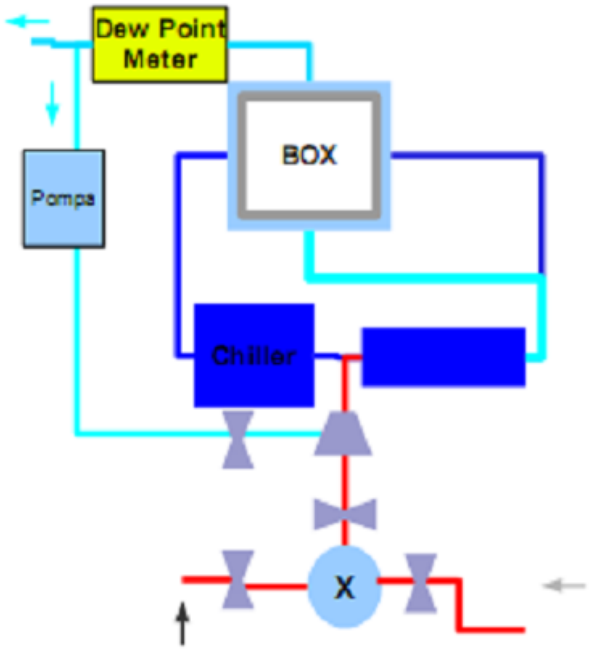
PH/DT test set-up

Test section



Thermally controlled liner

Ranges:
0% ≤ RH ≤ 100%
-20 °C ≤ T ≤ +30 °C

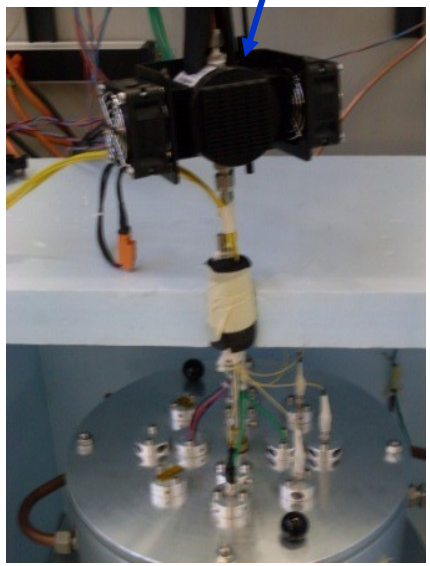


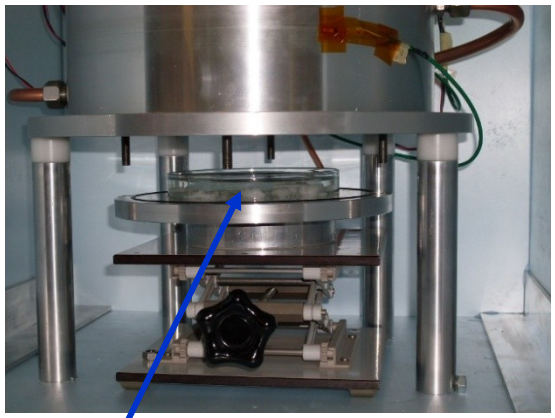
External air circulation
(dry + saturated air mixer)

Closed loop circulation
(salt solution in box)

Insulated confinement

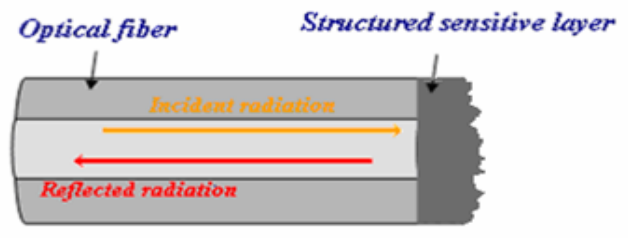
Chilled mirror

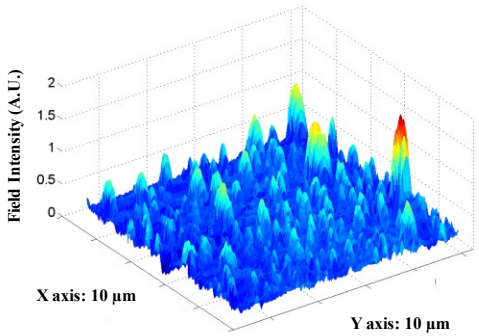


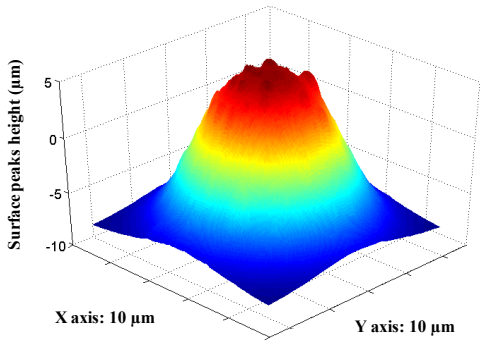


Salt solution container (if needed)

Phase I: tip-coated (NFFP) oxide sensors



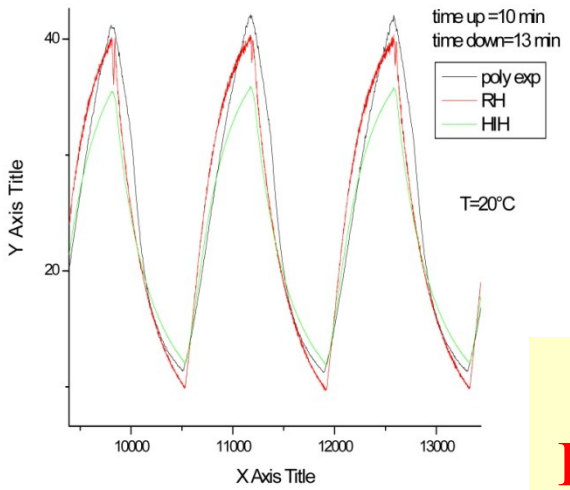




Build on previous experience of partner institutes (Unisannio, CNR-IMCB, DIBET) on Near-Field Fabry-Perot sensors for chemical applications

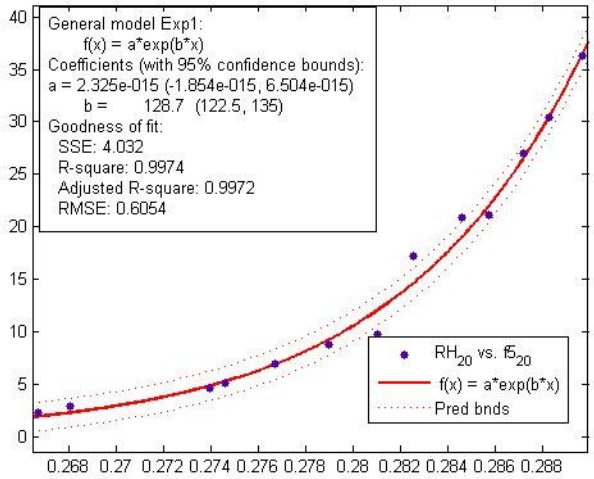
Optimal SnO_2 deposition: sub-wavelength bumps spaced by sub-wavelength distances (wavelength = 1.55 µm)

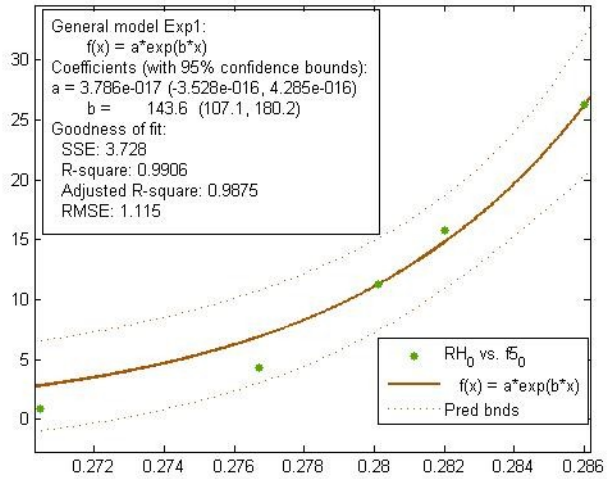
Phase I: tip-coated (NFFP) oxide sensors

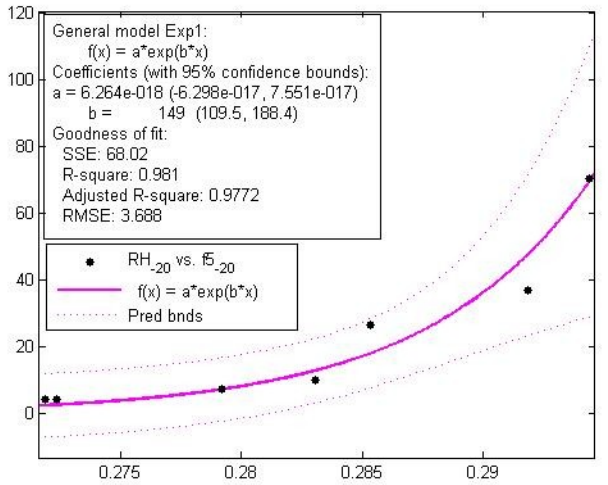


- Very good results obtained with two sensors on steady and dynamical behaviour between +20 °C and -20 °C
- Paper submitted to *Sensors and Actuators*
- Patent application filed

BUT EXTREMELY DIFFICULT TO REPRODUCE THE GOOD CONFIGURATION







Phase I: tip-coated (NFFP) oxide sensors

Help sought in PH/DT (A. Braem / T. Schneider) and TE/VSC (M.Taborelli) to investigate possible way to stabilize the production and obtain a reasonable yield

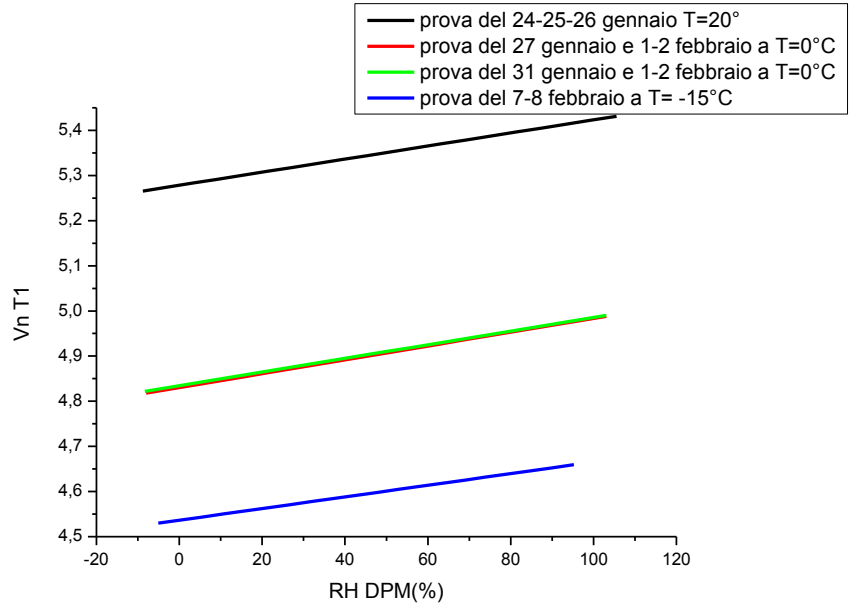
Two possible techniques have been envisaged and will be tried. Work performed on a “courtesy” base (i.e. depending on available windows), time scale not clear at the moment

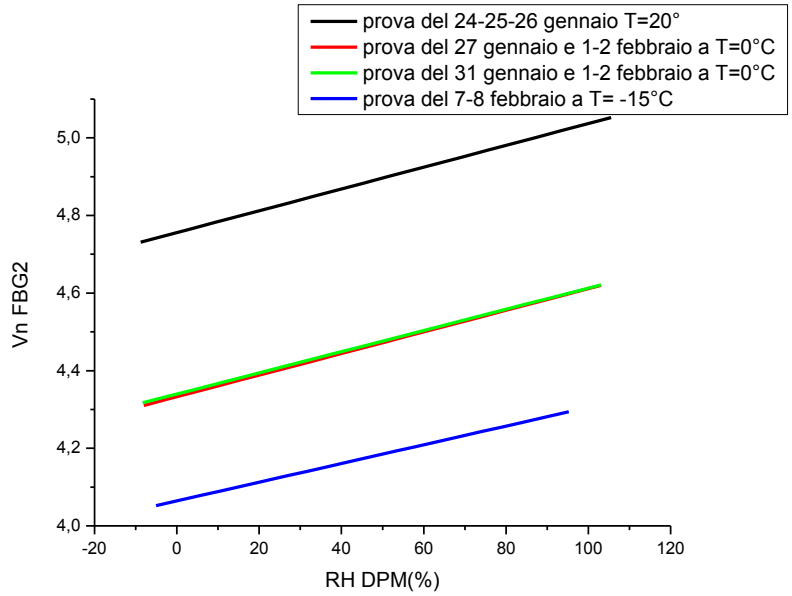
Phase II: FBG + polyimide sensors

Two examples have been recently reported in literature about successful use of polyimide-coated FBG as relative humidity sensors:

Kronemberg et al: *Relative humidity sensor with optical fiber Bragg gratings,* Optics Letters Vol. 27, No. 16 (2002)
Yeo et al: *Characterisation of a polymer-coated fibre Bragg grating sensor for relative humidity sensing.* Sensors and Actuators B, 110 (2005)

Extremely interesting results between +20 °C and – 20 ° C are being obtained in CERN PH/DT test set-up on two commercial FBG polyimide-coated in a non controlled way by the producer (insulation coating)





Phase II: FBG + polyimide sensors

•Similar sensors can be rather easily produced under controlled conditions by dip coating or by mould coating in a standard UV recoater

•Launched programme to investigate:
radiation hardness
effect of coating thickness
effect of polyimide type
reproducibility of the sensor
stability in time

•10 sensors (few μm polyimide coating) ordered from an external producer

•10 sensors to be produced in different (controlled) thicknesses @ CNR-IMCB

•Test production launched in parallel @ CERN (collaboration with TE/MPA)

Phase III: new collaboration agreement

Collaboration agreement for 2011 drafted, now under signature process

Programme:

LPG multi sensors coated with different oxydes (Sol-Gel deposition)
Partners: Unisannio + Uninapoli Federico II (DIBET)

FBG multi sensors coated with fully cured epoxy
Partners: CNR Napoli (IMCB) + Uninapoli Federico II (DIBET)

Results expected: Dec 2011