



Coating R&D at LMA : First measurements of Atomic layer deposited Ta_2O_5 thin films

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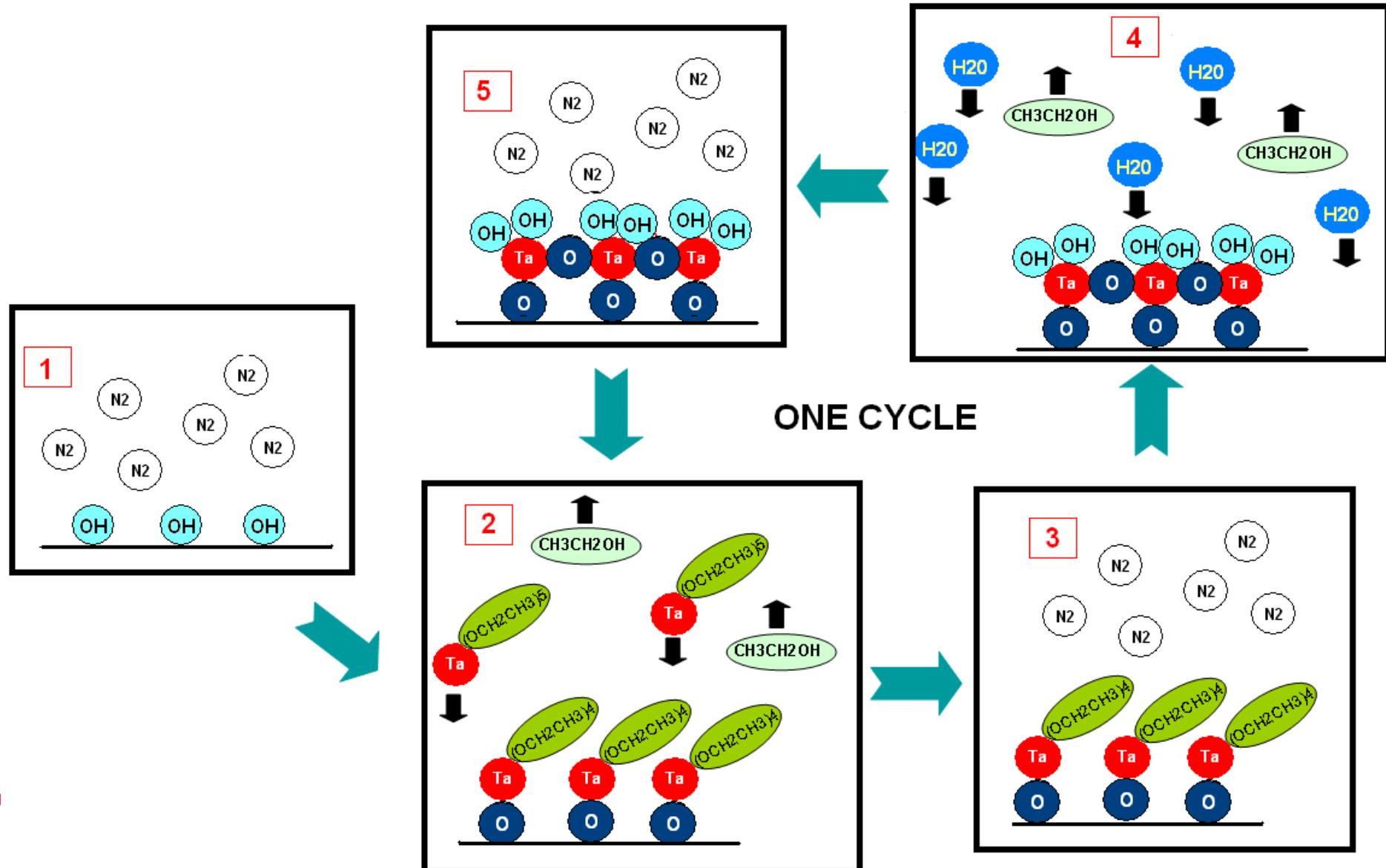
Inorganic chemistry laboratory of Helsinki



Janyce Franc - GWADW 2011



Principle : Atomic Layer Deposition (ALD)



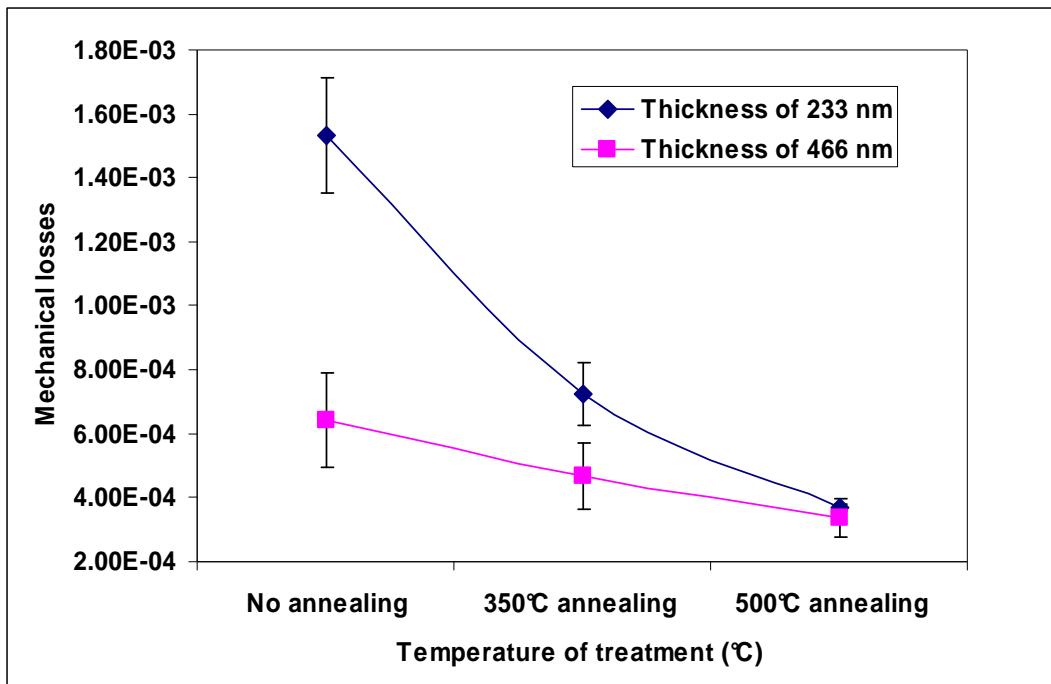
ALD : Mechanical losses measurement before and after annealing



Deposition all around the cantilever

2 thicknesses tested : 233 nm and 466 nm

Mechanical losses measurement :



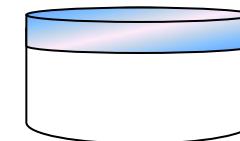
- 1) With no annealing, mechanical losses are higher for small thickness
2) After 500°C annealing, mechanical losses are the same for the two thicknesses

→ Results will be confirmed in the next few months with new measurements

ALD : optical characterization

Monolayer
 Ta_2O_5
500 nm thick

Ta_2O_5 thin film on 1inch diameter substrates
(two samples tested)

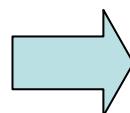


	Refractive index @ 1064 nm	Absorption
No annealing	2.016-2.019	0.9 ppm
350°C	2.038-2.041	46 - 49 ppm
500°C	2.056-2.06	0.8 - 1.9 ppm

Comparison IBS - ALD

Monolayer Ta_2O_5
500 nm thick
500 °C annealing

	IBS	ALD
REFRACTIVE INDEX	2.035 @ 1064 nm	2.058 @ 1064 nm
ABSORPTION	1.2 ppm	0.8 - 1.9 ppm
MECHANICAL LOSSES	$(3.0 \pm 0.6) 10^{-4}$	$(3.5 \pm 0.1) 10^{-4}$



RESULTS OBTAINED WITH ALD AND IBS ARE COMPARABLE

Coating R&D at LMA : other investigations

- STUDY of the annealing effect on Ti: Ta_2O_5 thin film

- No annealing
- Annealing under vacuum and pure O₂ flow
- Annealing in the air

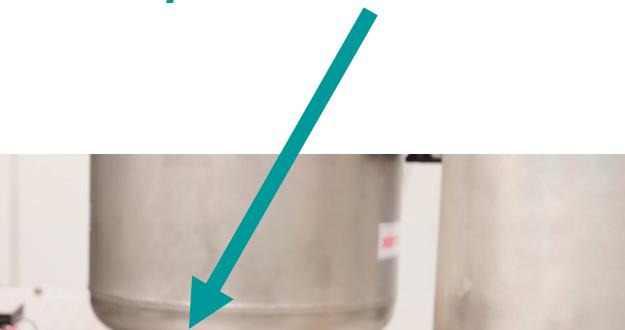
- XPS analysis of Ti: Ta_2O_5 thin film

- % Ta metallic less than 1%

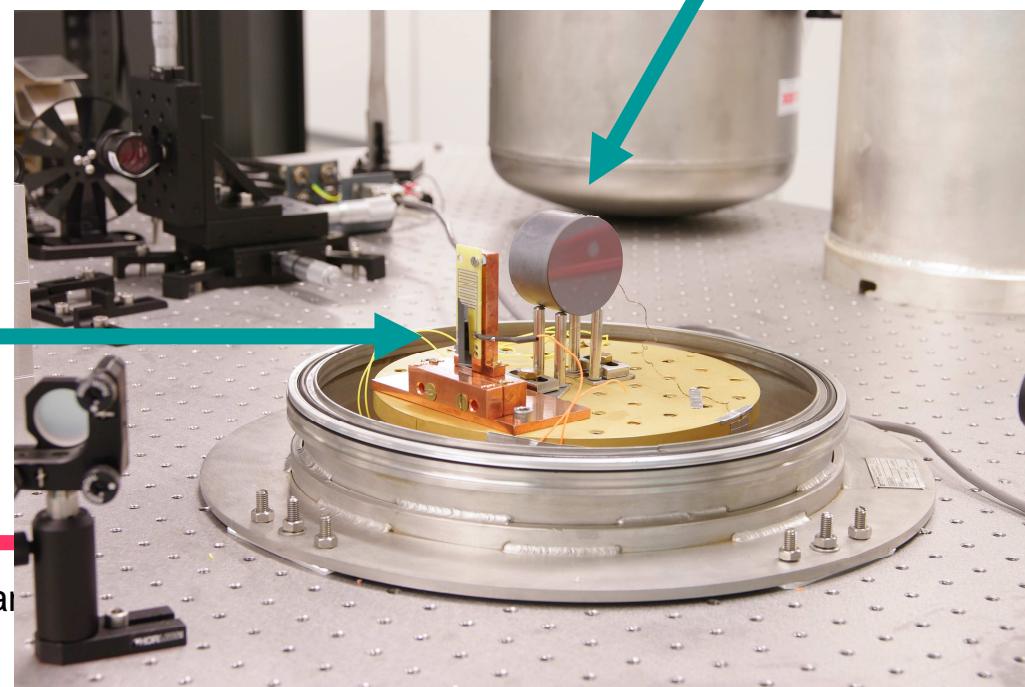
-New cryogenic activities since September 2010

- Absorption measurement of silicon
- Q measurements
- dn/dT (mid-term project)

Absorption measurement



Q measurement

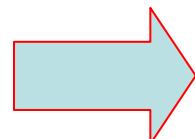


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Extra slides

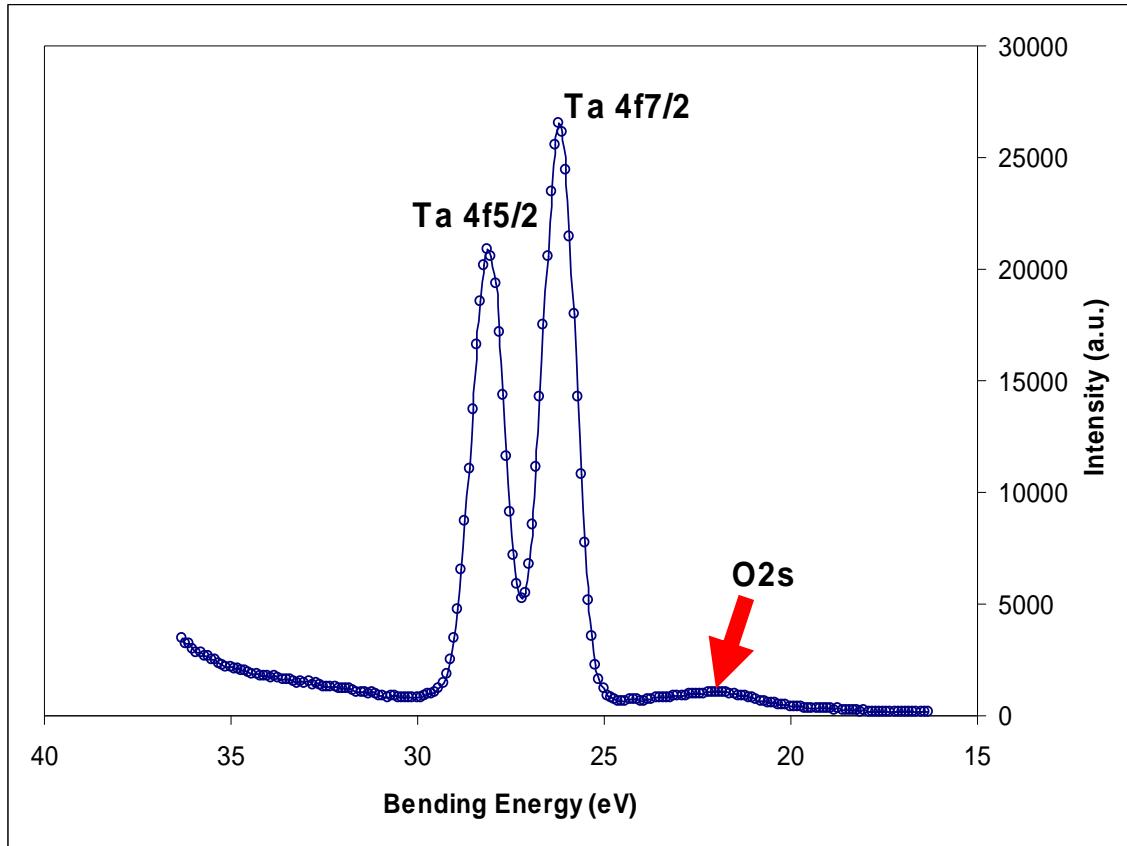
Annealing effects

	Mechanical losses (1 st mode)	Absorption
No annealing	$6.8 \cdot 10^{-4}$	X
500°C under vacuum + pure O ₂	$3.29 \cdot 10^{-4}$	72 ppm
500°C in the air	$2.8 \cdot 10^{-4}$	1 ppm



XPS analysis in progress

XPS analysis of Ti: Ta_2O_5 thin film



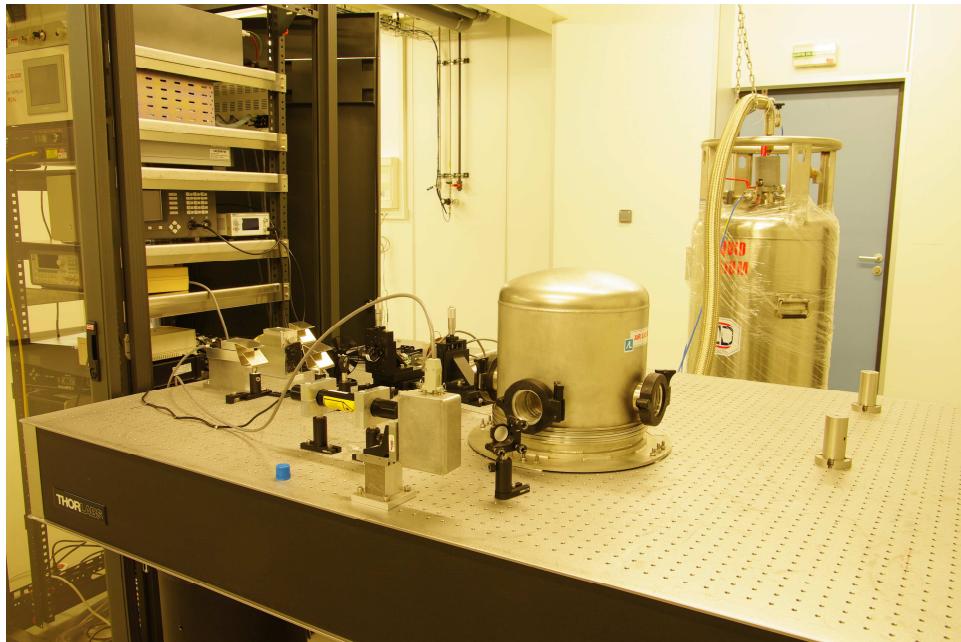
1. Not deconvoluted peak
2. Shift of Ox. peaks is the same

	O1s	O2s
Theoretical	531.5 eV	23.5 eV
Exp	530.2 eV	22.17 eV

3. Atomic ratio of Ox. = 1

$$\frac{NO_{1s}}{NO_{2s}} = 1$$

Cryogenic activities



Cryostat Helium liquid circulation
T°: 5K-300K

