	Experiment title: <i>In-situ</i> XRD study of the co-sputtering of ternary (Ni-Ti-X, X = Cu, Hf) SMA thin films	Experiment number: ME-936
Beamline: BM 20	Date of experiment: from: 16.02.2005 to: 22.02.2005	Date of report: 28.02.2005 <i>Received at ESRF:</i>
Shifts: 18	Local contact(s): Dr. Norbert Schell	
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Report:

Previous experiments at ROBL were carried out using separate NiTi and Ti targets:

- **20_02_608 and ME-584** where the power applied to each magnetron was kept constant
- **ME-814**, where the power was varied.

This new series of experiments was intended to make the *in-situ* study of the structural evolution during co-sputtering using NiTi and Ti/Hf/Cu targets, testing also the change of substrate: Si (100) oxidized, MgO (100) and MgO (111).

EXPERIMENTAL

The experimental conditions used are presented at the following table.

sample	Power applied to the 2 nd magnetron (W)				Substrate			
	NiTi	Ti	Hf	Cu	Si oxydized	Si (100)	MgO (100)	MgO (111)
S23	40	20			X			
S24	40	20					X	
S25	40	20						X
S26	40		15			X		
S27	40		20			X		
S28	40			20		X		

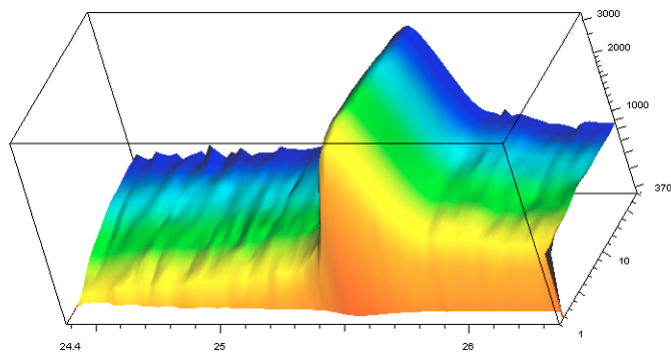
RESULTS

The depositions performed using Ti as a second magnetron, showed a strong influence of the substrate on the preferential stacking of NiTi sputtered. Previous experiments of the same type with deposition on Si(100) have put in evidence that the first layers were stacking preferentially on (100), changing later to (110) preferential orientation. Now, the experiments carried on using Ti as a 2nd target and using Si(100) oxydized, MgO (100) and MgO (111) have shown:

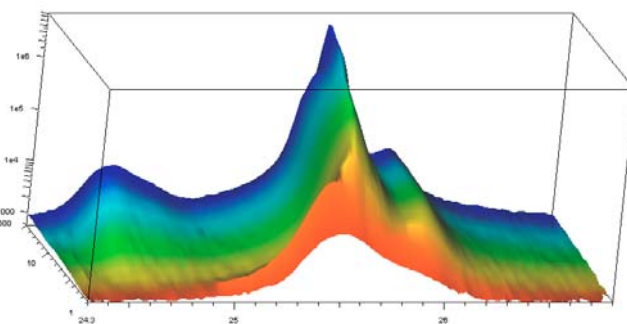
- preferential stacking of (100) of B2, when using the substrates Si(100) oxydized and MgO (100),
- preferential stacking of (110) of B2, when using the substrate MgO (111).

The preferential orientation of B2(100) // MgO(100) and B2(110) // MgO(111) were very strong and were kept as such until the end of the deposition, which lasted for 2 hours (circa 3500 Å thick film).

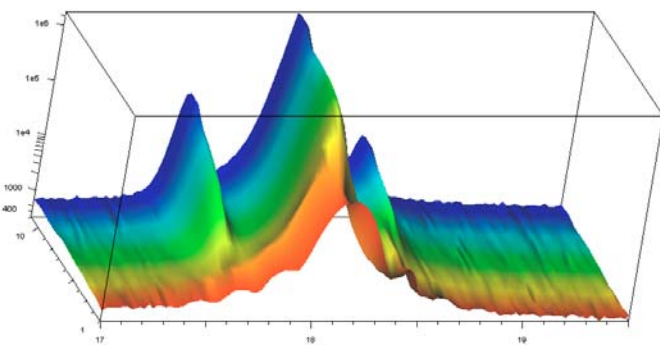
The experiments using the Hf and Cu targets allowed us to identify the 2θ ranges where the most relevant changes of the diffraction peaks shall appear along the deposition.



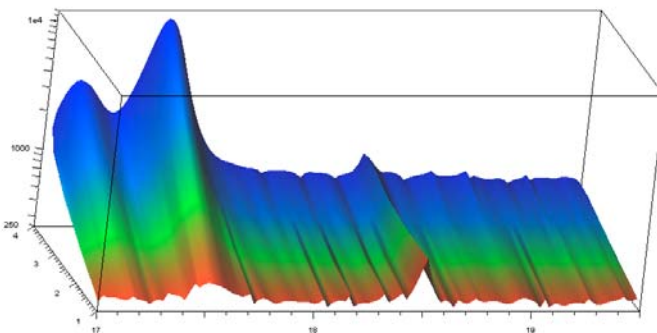
S23 during deposition



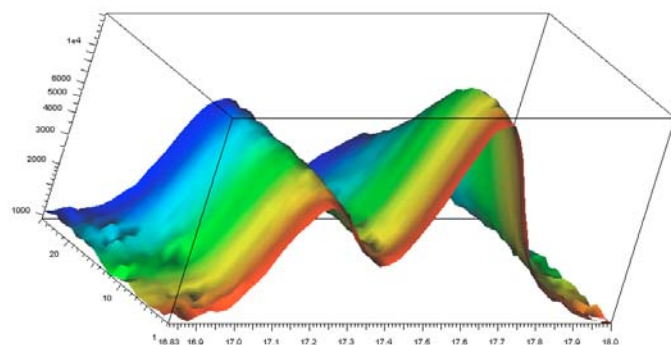
S24 during deposition



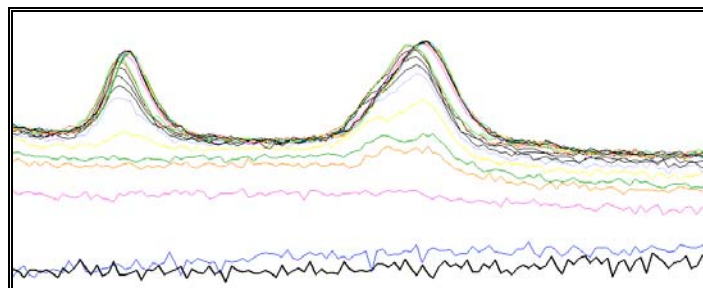
S25 during deposition



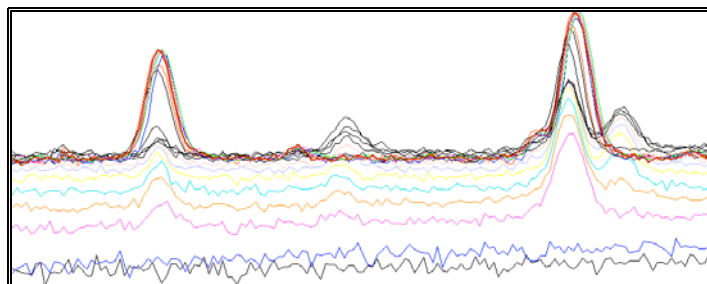
S26 during deposition



S26 during cooling



S27 (15.5 < 2θ < 18)



S28 (15.5 < 2θ < 18)

CONCLUSIONS

The additions of Cu and Hf can give deeper information concerning the stacking preference of NiTi-based thin films due to the different “preferences” of site occupations: while Cu tends to replace Ni, Hf tends to replace Ti positions. Further experiments are required to the effect of these site replacements on the type of preferential orientation of the sputtered films. These results should be coupled with the binary NiTi experiments on different substrates in order to give a better understanding of the structure of the sputtered thin films.