

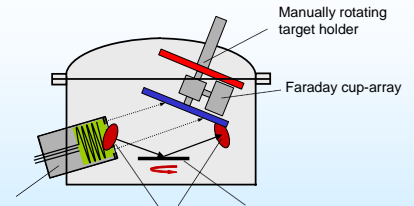
Introduction

- Ellipsometry is an optical method which measures the relative amplitude and phase of reflected light. Information of structural and optical properties of arbitrary thin film stacks can be obtained.
- In-situ ellipsometry additionally provides information on growth rate, interface roughness, crystallization regime
- Mo/Si multilayers are grown on [001] Si substrates by Argon ion beam sputter deposition. The growth is in situ monitored by spectral ellipsometry.
- Multilayers are ex situ characterized by TEM, AFM, hard and soft x-ray reflectometry
- Single layer and period thicknesses compared to each other

Experimental Setup

Sputter conditions:

P_{tot} : 2×10^{-8} mbar
 P_{proc} : 8×10^{-4} mbar
 f_{Ar} : 2.8 sccm
 T : 300 K
 P_{HF} : 85 W
 E_{ion} : 0.7 keV
 i_{ion} : 1.7 mA/cm²

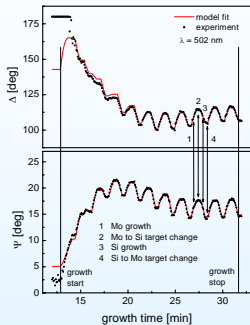


HF ion source \varnothing 40 mm connected with electronic beam switch for time control

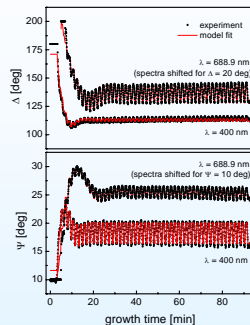
Ellipsometry ports 88 wvl., ellipsometry 75° angle of incidence time resolution: 1.7-4.3 sec

Results and Discussion

10 period Mo/Si multilayer



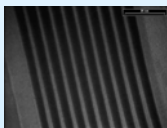
50 period Mo/Si multilayer



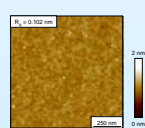
Comparison of period and single layer thickness

Sample	Single layer thickness		Period length		
	Ellipsometry	Calculated from single film growth rate	Elli.	Refl.	TEM
	d_{Mo} [Å]	d_{Si} [Å]	d_{Mo} [Å]	d_{Si} [Å]	d_p [Å]
1	27.6	39.3	26.6	31.9	68.0
2	31.1	40.2	27.5	30.9	71.3
3	26.7	43.3	23.3	33.8	70.0
4	21.4	49.1	18.3	38.7	70.5
5	32.8	22.0	33.3	18.4	54.8
6	26.5	41.8	26.6	31.9	68.3

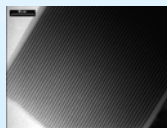
TEM



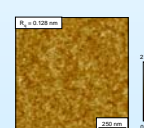
AFM



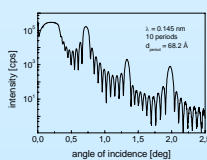
TEM



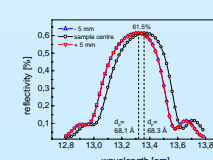
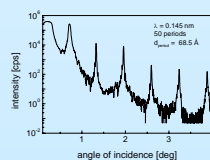
AFM



CuK α -Reflectivity



EUV-Reflectivity



Summary

- in situ ellipsometry is suitable for online monitoring of multilayer growth
- ion beam sputter deposition is an appropriate method for high-quality multilayer growth (excellent interface and surface properties)

Acknowledgement

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