Monoclinic Optical Properties of Slanted Columnar Thin Films

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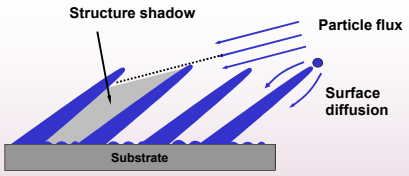
Our Message

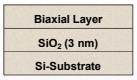
- Glancing angle deposition is utilized to grow slanted columnar thin films (SCTFs) from metal
- Generalized ellipsometry is used to determine optical and structural properties of such highly anisotropic films
- Each SCTF has two pseudo-isotropic orientations (*c*-axis || plane of incidence)
- SCTFs have monoclinic optical constants that differ drastically from their bulk material
- SCTFs composed of different materials, but similar morphology, have similar optical properties
- Optical properties of SCTFs are rather determined by morphology than material

Glancing Angle Deposition



The incoming particle flux at glancing angle causes self-organized columnar growth due to preferential growth of nucleation sites, structure shadowing, and limited surface adatom movement.

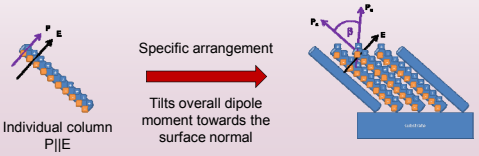
Model and Theory



Variable parameters in Biaxial Layer

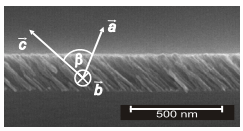
d	thickness
φ	in-plane orientation
θ	tilting angle
β	monoclinic angle
n,k	along principal axes **a**, **b**, **c**

Monoclinic Angle β



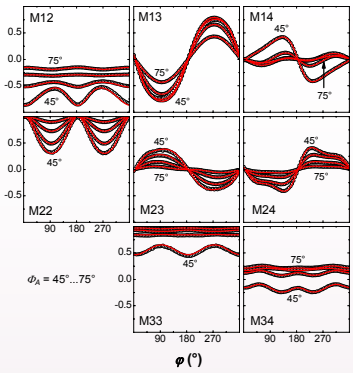
Optical Properties of Slanted Columnar Thin Films

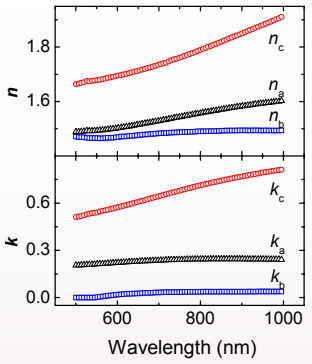
Titanium

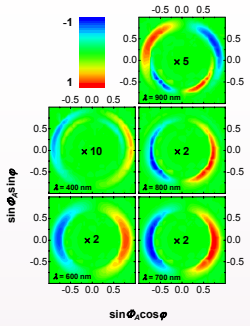


	GE	SEM
Thickness *d*	178.9 nm	≈ 196 nm
Inclination θ	46.7°	≈ 47°
Angle β	67°	---

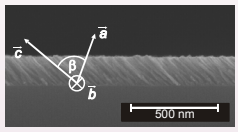
D. Schmidt *et al.*, Appl. Phys. Lett. **94**, 011914 (2009).





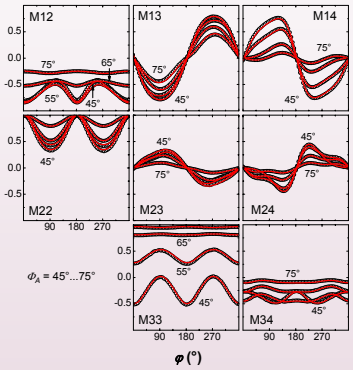


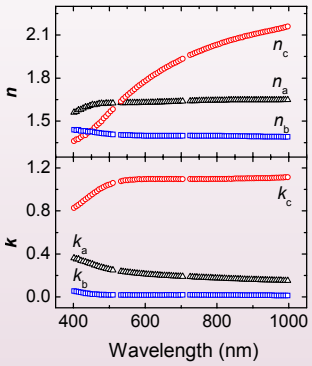
Chromium

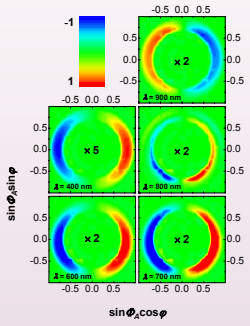


	GE	SEM
Thickness *d*	150.4 nm	≈ 161 nm
Inclination θ	45.2°	≈ 46°
Angle β	74.8°	---

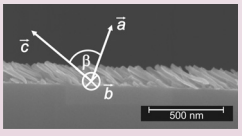
D. Schmidt *et al.*, Opt. Lett. (submitted, 2009).





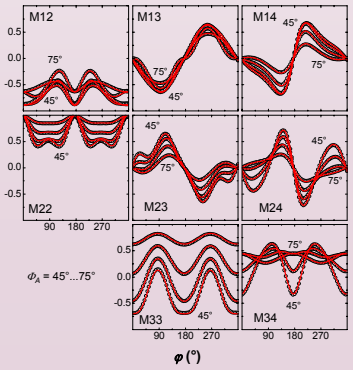


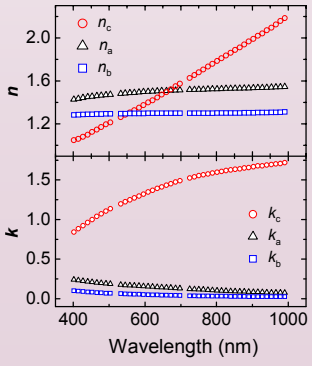
Cobalt

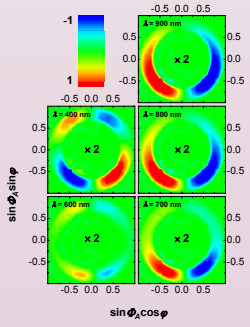


	GE	SEM
Thickness *d*	113.4 nm	≈ 125 nm
Inclination θ	55.3°	≈ 55°
Angle β	80.6°	---

D. Schmidt *et al.*, Mat. Res. Soc. Symp. Proc. **1042**, xx (2009).







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