Isotropic and anisotropic behaviors in microstructured thin films

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We studied the surface acoustic wave propagation in columnar thin films using a femtosecond heterodyne pump probe setup. Two kinds of thin films were prepared using the Glancing Angle Deposition (GLAD) process : films with isotropic columns and films with anisotropic columns.

Femtosecond pump probe setup (TDTR)

- 2 femtosecond lasers with different repetition rates

  f_p ~ 48,1 MHz

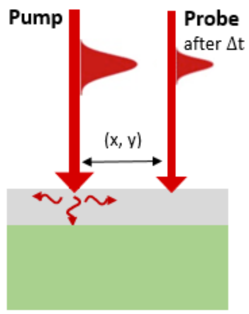
  $f_s = f_p - \Delta f$ with Δf ~ 700 Hz

→ Increasing pump-probe delay by $\delta t = T_s - T_p$ ~ 300 fs

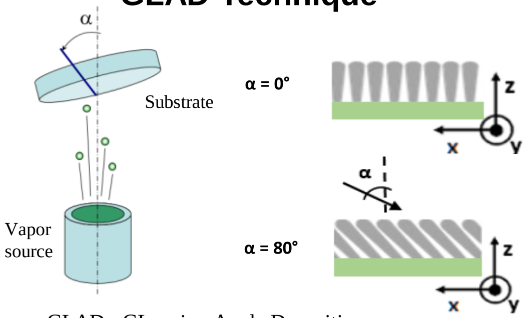
With scanning :

→ Acoustic wave velocity V_x and V_y

→ Acoustic anisotropy

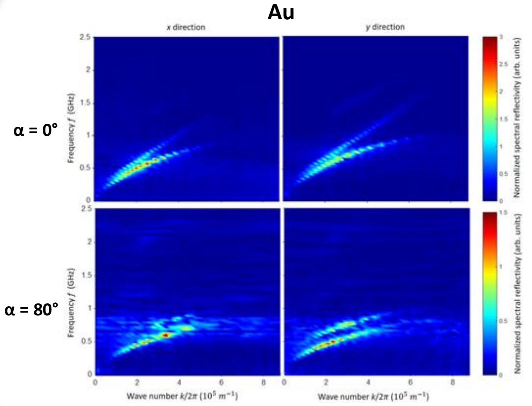


GLAD Technique



- GLAD : GLancing Angle Deposition
- Sputtering technique on an oriented substrate
- Fixed or moving substrate

Surface acoustic wave propagation



Dispersion curves of Au films for x and y directions

- Scan over a 55 µm^2 window by moving the relative position of the lasers

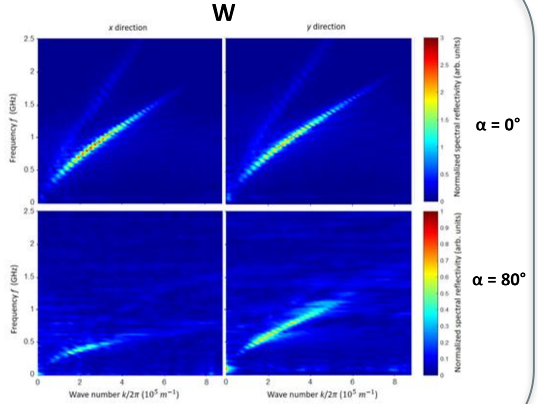
- **α = 0°**

  $V_x = V_y$ for Au and W films

  →Isotropic in-plane properties

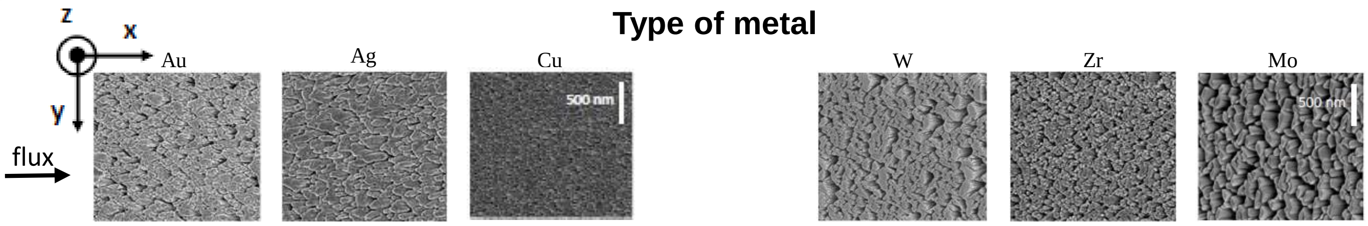
- **α = 80°**

  - Au : $V_x = V_y$ → isotropic microstructured film
  - W : $V_x < V_y$ → anisotropic microstructured film

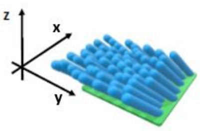


Dispersion curves of W films for x and y directions

Type of metal

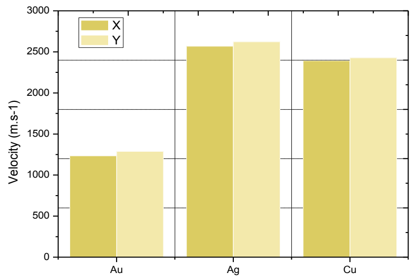


Tilted isotropic columns

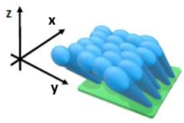


Circular shape

$V_x = V_y$

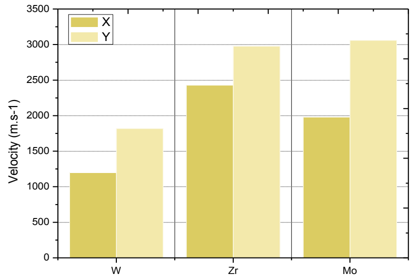


Tilted anisotropic columns



Elliptical shape

$V_x < V_y$



In thin film deposition, the GLAD approach is among the most attractive ways to produce original surface morphologies, especially to tune the surface anisotropy.
For this technique, the microstructural anisotropy can be changed as a function of the incident angle of the particle flux, the sputtering pressure and the thickness of deposit (work in progress).

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