Introduction and research context

Research context and motivation:
- Gold NPs embedded in PVA used as SATURABLE ABSORBERS in passive Q-switch systems: importance of roughness
- Optical properties of metal nanoparticles (NPs) determined by a collective oscillation of the conduction electrons: localized surface plasmon resonance (LSPR).
- Model system: Au NPs in a poly(vinyl alcohol) (PVA) matrix and chemical reduction of the metal salt by thermal annealing of the film (λ_{spr} = 530 nm)
- In situ route for synthesis: spontaneous encapsulation in a matrix during synthesis but less control on the shape/size of the NPs

Optical characterization:
- Study by home-build spectroscopic reflectometer with CSS200 Thorlabs spectrometer (integration time: 12 ms) and temperature control.

Experimental results

Monitoring of the gold NPs growth: LOCAL versus GLOBAL changes of optical properties

**Imaging ellipsometry (IE) maps of Au-PVA film [A] before annealing and [B] after 60 min annealing at 140°C:** gold NPs induce optical diffraction – Onset of depletion zones

**Spectroscopic reflectivity (SR) of [A] Au-PVA film and [B] PVA film during the annealing (changes in the first 720s due to the glass transition: dashed line)***

**No clear changes with time on the SR map and visible changes on the IE map**

Bidirectional reflectance distribution function

**The BRDF of a surface is the ratio of reflected radiance to incident irradiance at a particular wavelength for all scattering angles**

**BRDF - Scattered intensity at \( \lambda = 570 \text{ nm} \)**

Top: BEFORE annealing, Bottom: AFTER annealing (90 min, 135°C)

- Scattering strongly induced by NPs growth
- Important backscattering component
- Measurement system: EZ Contrast, ELDIM, France

Conclusions and acknowledgements

- At low Au-doping levels, IE is much more sensitive than conventional SR because it provides a LOCAL information on optical properties
- Light (back)scattered by the annealed sample due to the growth of the gold nanoparticles