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Synthesis of anisotropic Au, Pd/Au and Pd NPs via oblique angle deposition on glass: Plasmon resonance and sensing applications

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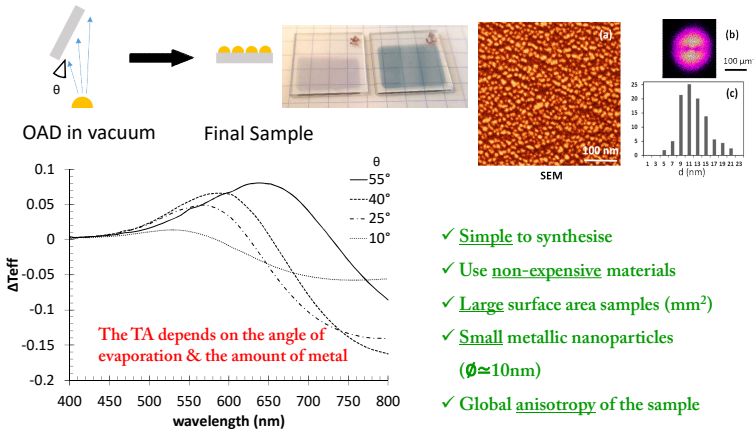
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Motivations

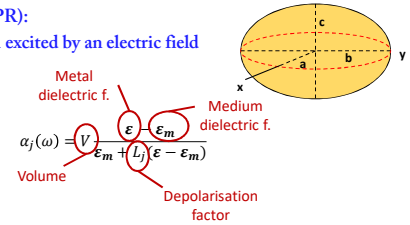
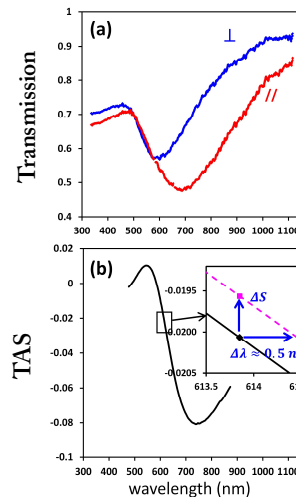
- Plasmonic sensors limited by monochromator resolution
- Use of RAS with anisotropic NPs for increasing sensitivity
- Nanoparticle (NP) synthesis by Oblique Angle Deposition
- Comparison of Au, Pd/ Au and Pd NPs with H₂

Oblique Angle Deposition - Dichroism



Use of RAS for LSPR investigation

Localised Surface Plasmon Resonance (LSPR):
 Collective oscillation of conduction electron excited by an electric field



Transmission Anisotropy

$$TAS = \frac{T_{\perp} - T_{\parallel}}{1/2(T_{\perp} + T_{\parallel})}$$

Spectroscopy

Mirror

Anisotropic sample

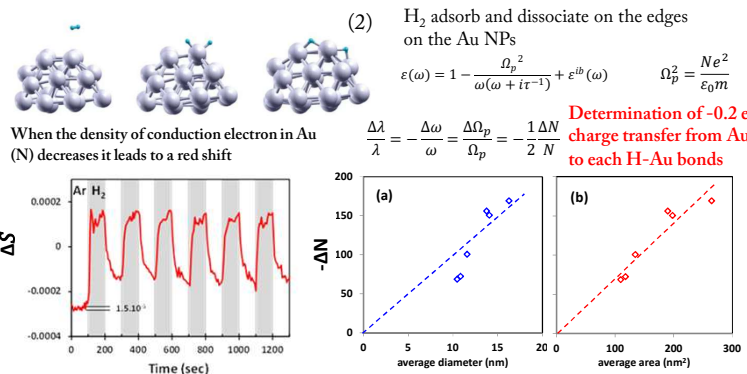
RAS

Measuring the variation of the TAS at a single wavelength is much more precise than measuring wavelength shift (1)

(1) Verre, R., et al. (2016). *Nanoscale*, 8(20), 10576–81.

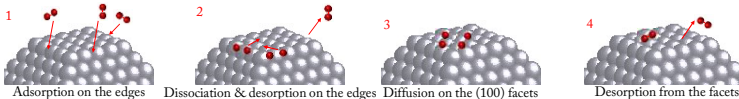
Application to H₂ sensing by NPs

H₂ on Au



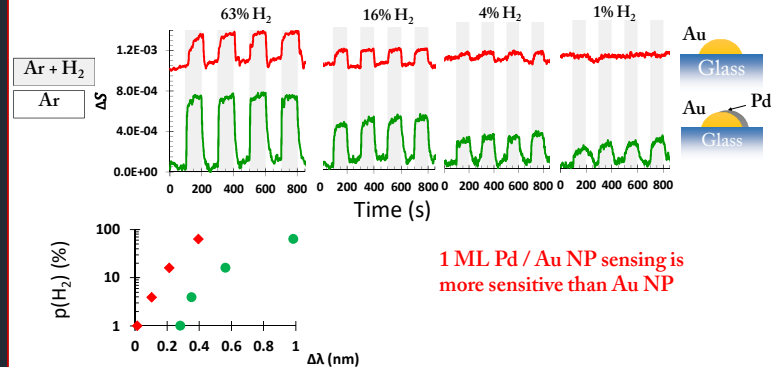
ΔN varies not with the diameter but with the average surface area

This demonstrates that H atoms diffuse on the facets of the NPs

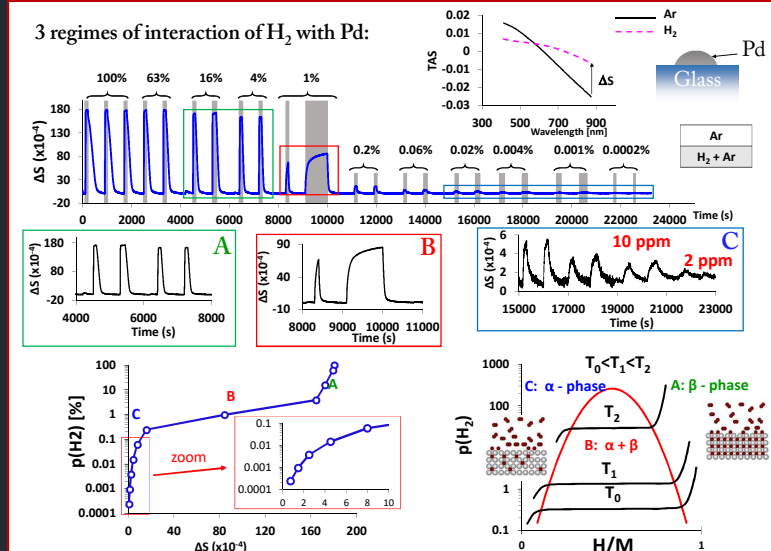


(2) Illas, F. et al. (2007). *Chem. Com.* (32), 3371–3373.

H₂ on Pd/Au



H₂ on Pd



Conclusion

- Probing interaction of H₂ with Au using RAS allows to go beyond the resolution of conventional methods.
- Possibility of detecting H₂ with an indirect Pd/Au sensor.
- Possibility of measuring 2 ppm of H₂ in Ar with a simple Pd sample.
- Perspectives : Other gases, biochemical compounds