

COMONSENS (JCJC 2010)

Controlled and reversible modulation of the optical response of noble metal nanoassemblies for biosensing in microfluidic systems

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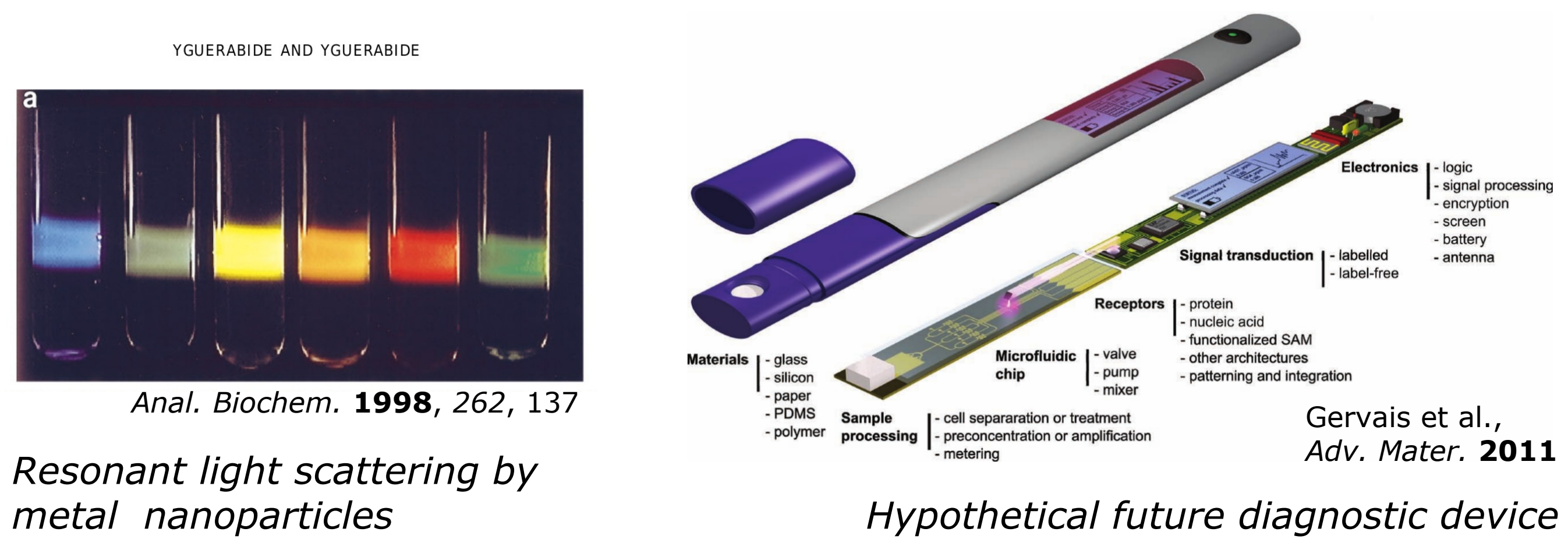
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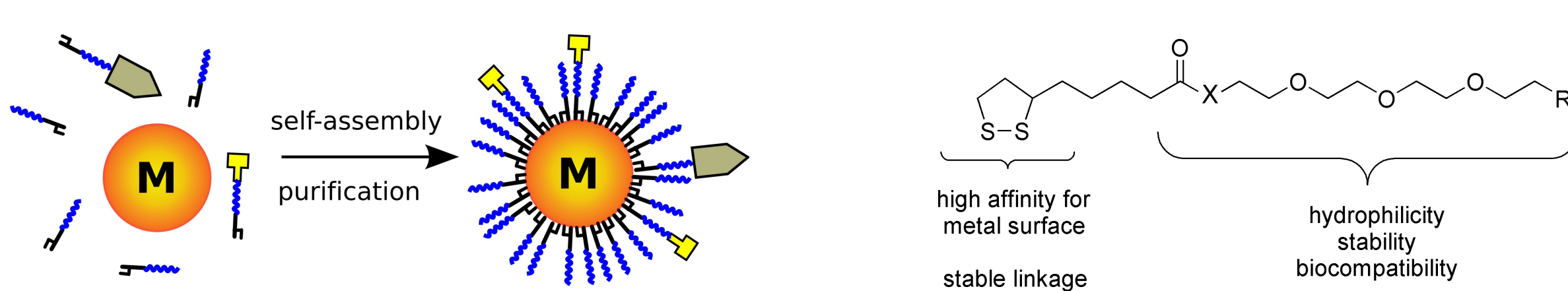
Context & aim

Gold and silver nanostructures display a strong interaction with visible and near-infrared light. Understanding, controlling and exploiting this interaction is the aim of the field now called **plasmonics**. Plasmonics is giving rise to advances in many domains involving light-matter interactions, such as **spectroscopy**, photochemistry, **photovoltaics**, optical information processing, and **biophotonics**.

The **COMONSENS project** investigates **bottom-up assembly** of hybrid **plasmonic nanostructures** by wet-chemical methods, and in particular the combination with **microfluidic technologies** and optical microspectroscopy for the development of novel (miniaturised) **biosensing schemes**. These may become part of future clinical diagnostic or theranostic devices (see Figure). Additionally, **microfluidics** is an excellent **tool** for controlling nanoparticle **chemistry and self-assembly**, which can readily be combined with **spectroscopic tools**.



Functionalised nanoparticles

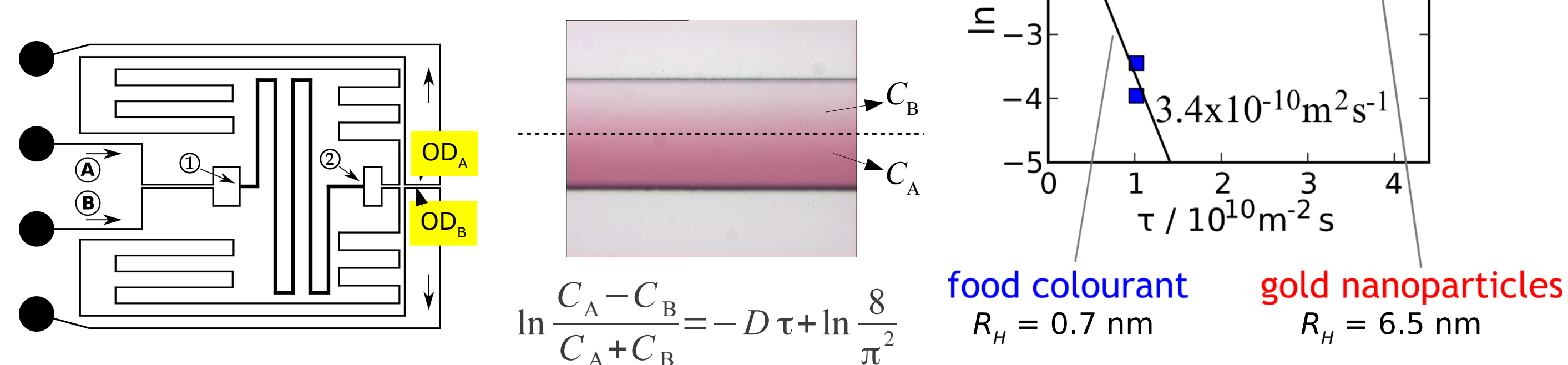


Organic ligands for nanoparticle functionalisation have been successfully synthesized. Not all combinations of ligands and gold/silver nanoparticles (of various diameters) give rise to stable suspensions.

Nano-waste treatment: spent nanoparticle suspensions are treated with an etchant which converts the nanoparticles into 'non-nano' salts.

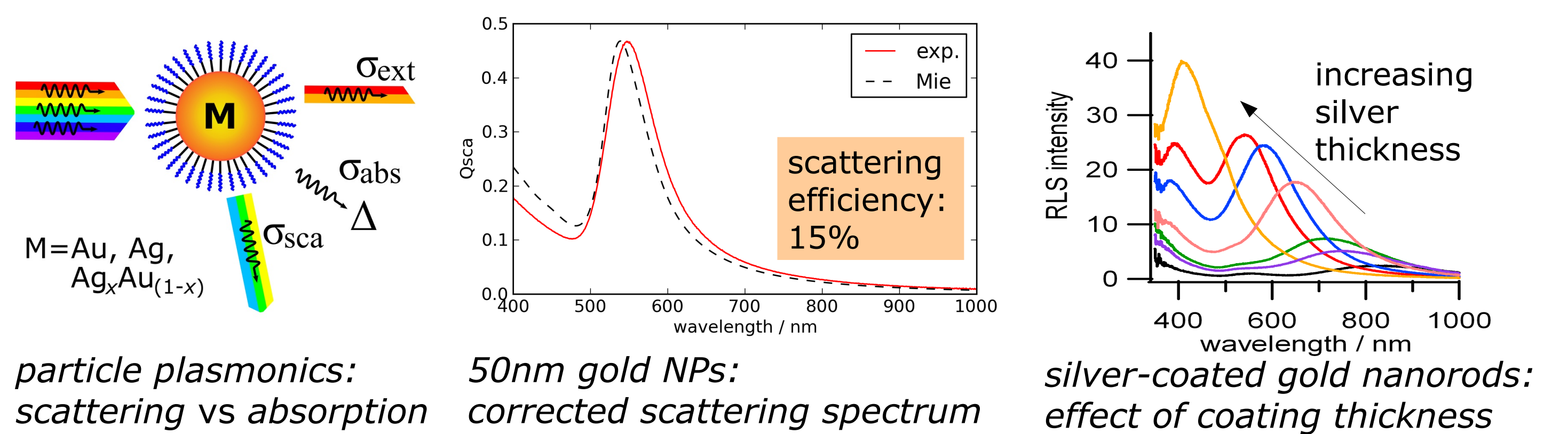
Péclet-O-Matic

Knowledge of the diffusion coefficient is highly useful for the characterisation of NP assemblies. An innovative microfluidic device for diffusion measurements has been developed, together with quantitative microscopic image processing.



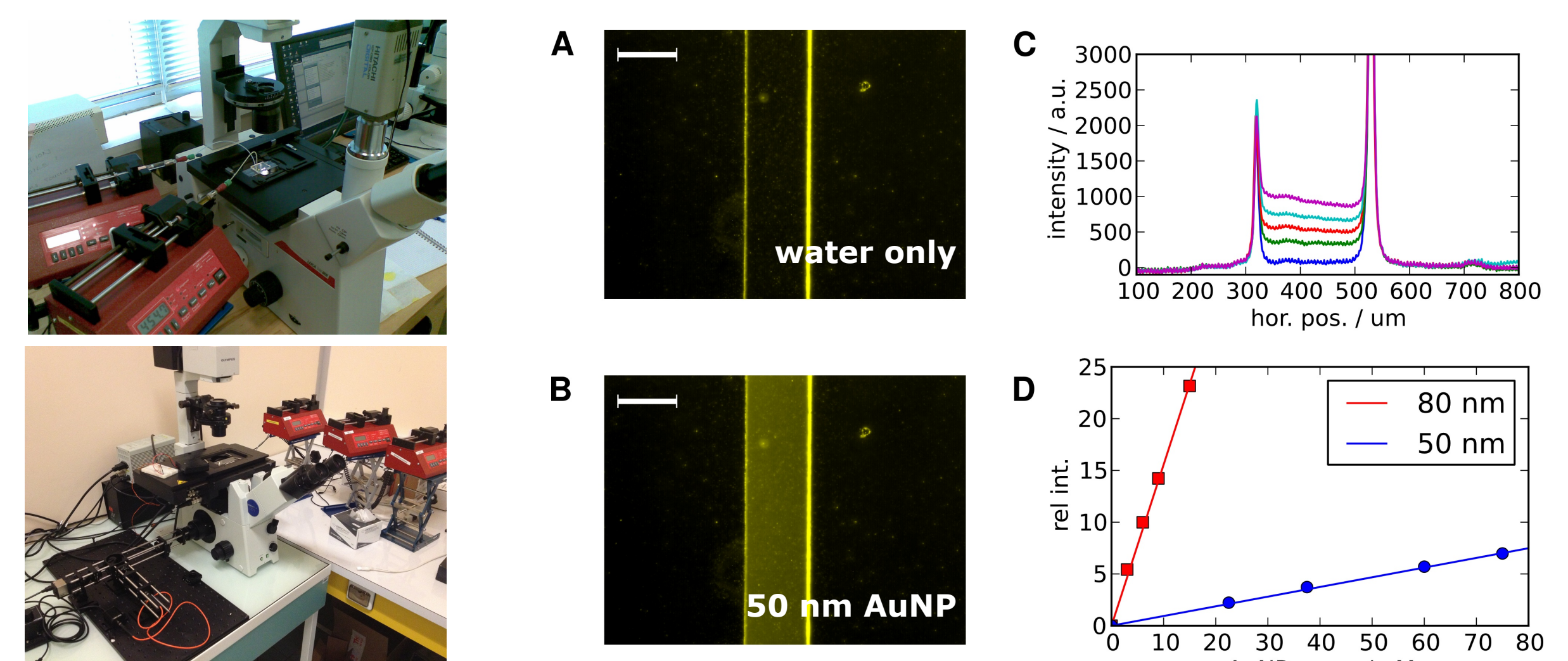
Resonant light scattering spectroscopy

In order to study the light scattering properties of metal nanoparticles and their assemblies in solution, we developed methods for quantitative measurements of scattering spectra and scattering efficiencies (brightness, cross section)

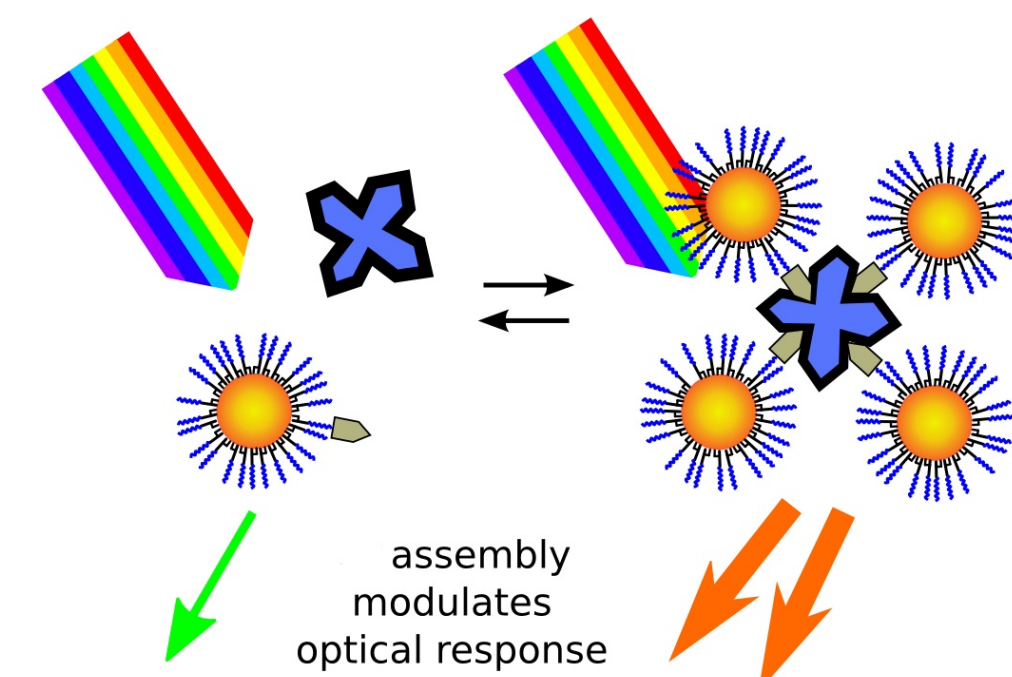


Microfluidic detection using plasmonic light scattering

The resonant light scattering by gold and silver nanoparticles can be detected in microfluidic channels using dark-field illumination. Scattered light is imaged using a conventional CCD camera but can also be analysed using a spectrometer.

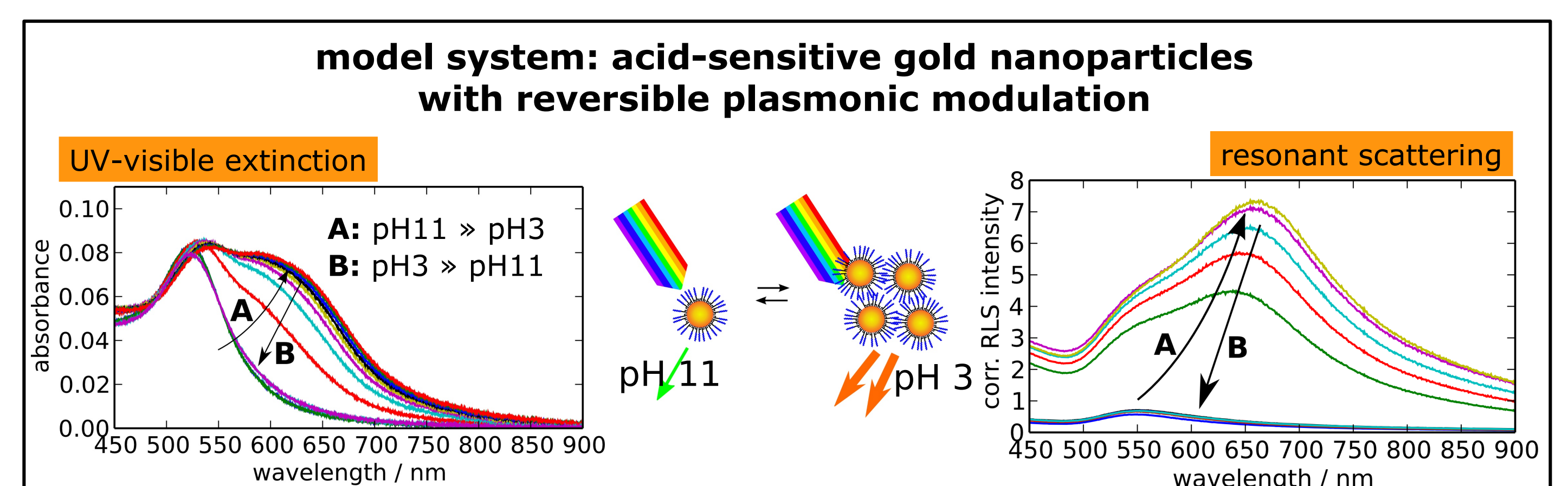


Analyte-induced modulation of plasmonic response



Some examples of accessible analytes:

- DNA (Elghanian et al., *Science* 1997)
- biotin-avidin (Aslan et al., *JPCB* 2004)
- antibody-antigen (Englebienne, *Analyst* 1998)
- cation chelation (Kalluri et al., *Angew. Chem.* 2009)
- hydrogen bonding (melamine: *JACS* 2009, 131, 9496)



Publications

M.H.V. Werts, V. Raimbault, R. Texier-Picard, R. Poizat, O. Français, L. Griscom, J.R.G. Navarro. "Quantitative full-colour transmitted light microscopy and dyes for concentration mapping and measurement of diffusion coefficients in microfluidic architectures", *Lab on a Chip* 2012, 12, 808-820

J. Emile, M.H.V. Werts, F. Artzner, F. Casanova, O. Emile, J.R.G. Navarro, F. Meneau. "Foam films in the presence of functionalized gold nanoparticles", *Journal of colloid and interface science* 2012, 383, 124-129

J.R.G. Navarro, M.H.V. Werts. "Resonant light scattering spectroscopy of gold, silver and gold-silver alloy nanoparticles and optical detection in microfluidic channels", *Analyst*, DOI:10.1039/C2AN36135C, in press

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