Glowing Microfluidics

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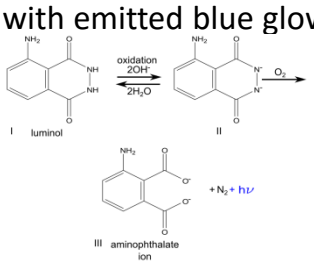
Introduction

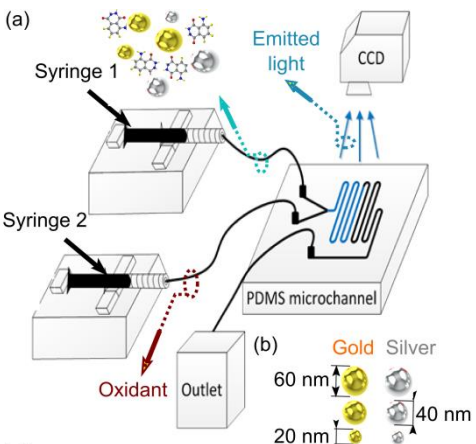
Chemiluminescence is a fascinating optical effect that finds its use in various application areas: from forensic science to industrial bio-chemistry. Luminol is a chemical that exhibits chemiluminescence with emitted blue glow light.



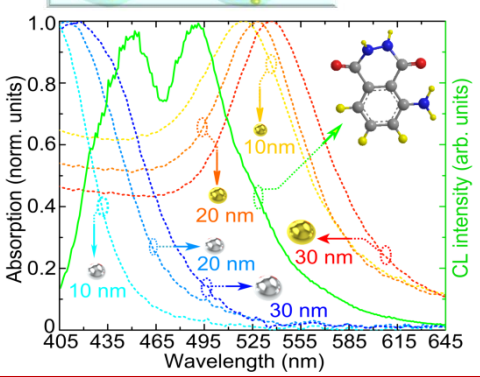
The chemiluminescence reaction of luminol $C_8H_7N_3O_2$ (I) in relatively nonacidic solvents resulting in aminophthalate ion (III) which is a light emitting species

Materials and Methods

We have designed and fabricated a reusable microflow[4,5] device with a serpentine channel of 600 mm width, 200 mm depth and 600 mm length formed in polydimethylsiloxane (PDMS). Diluted oxidant NaOCl was injected into one part of the flow and diluted luminol molecules were introduced in its other part.

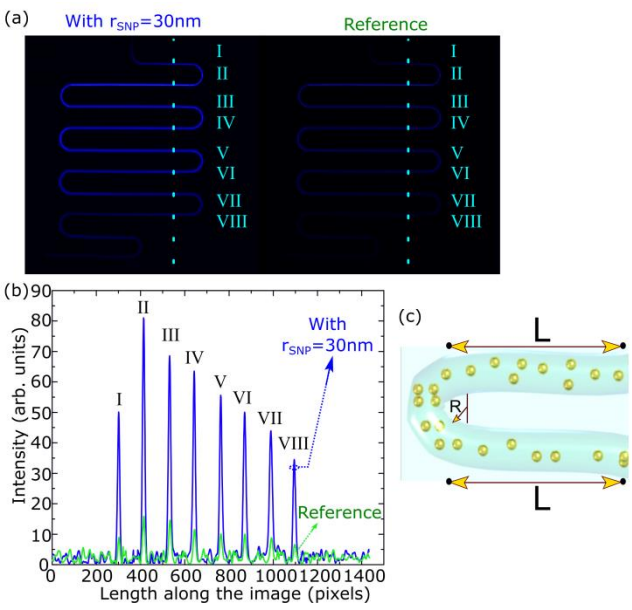


Overlap between measured chemiluminescence intensity of the luminol solution and the absorption spectra (dashed) of gold and silver nanoparticles acceptors.



Results

Here we observe[1] an enhancement of the chemiluminescence intensity of a luminol flow in the presence of metallic nanospheres on a microfluidics chip. Experimental results below captured by the CCD camera (a) shows glowing serpentine channel compared to the Reference. Luminol has been injected with the flow rate of 0.35 mL/sec.



Conclusions

To conclude, we proposed two possible mechanisms for chemiluminescence enhancement during flow injection: 1) The rate of emission by a chemophore emitter can be enhanced by an antenna effect. The Purcell effect may be responsible for the amplification of the radiative decay rate by the enhanced density of optical states accessible for decay of the molecular excitation. 2) Observed enhancement and modification of the spectral shape could be also due to the far-field scattering.

References

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