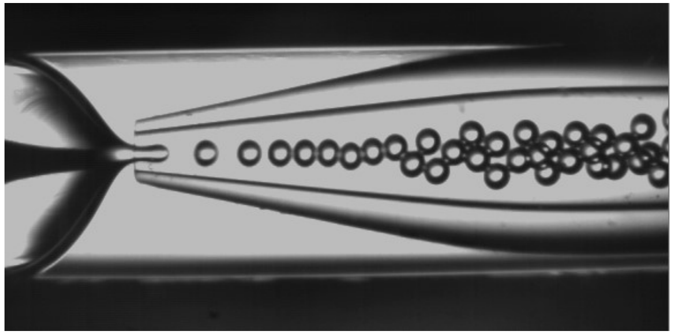
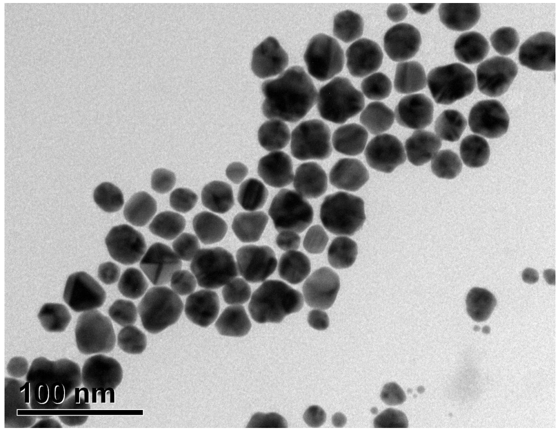
Production of biocompatible gold nanoparticles using glass capillary microfluidic devices for drug delivery applications - presentation

Production of biocompatible gold nanoparticles using glass capillary microfluidic devices for drug delivery applications



Monalie Bandulasena



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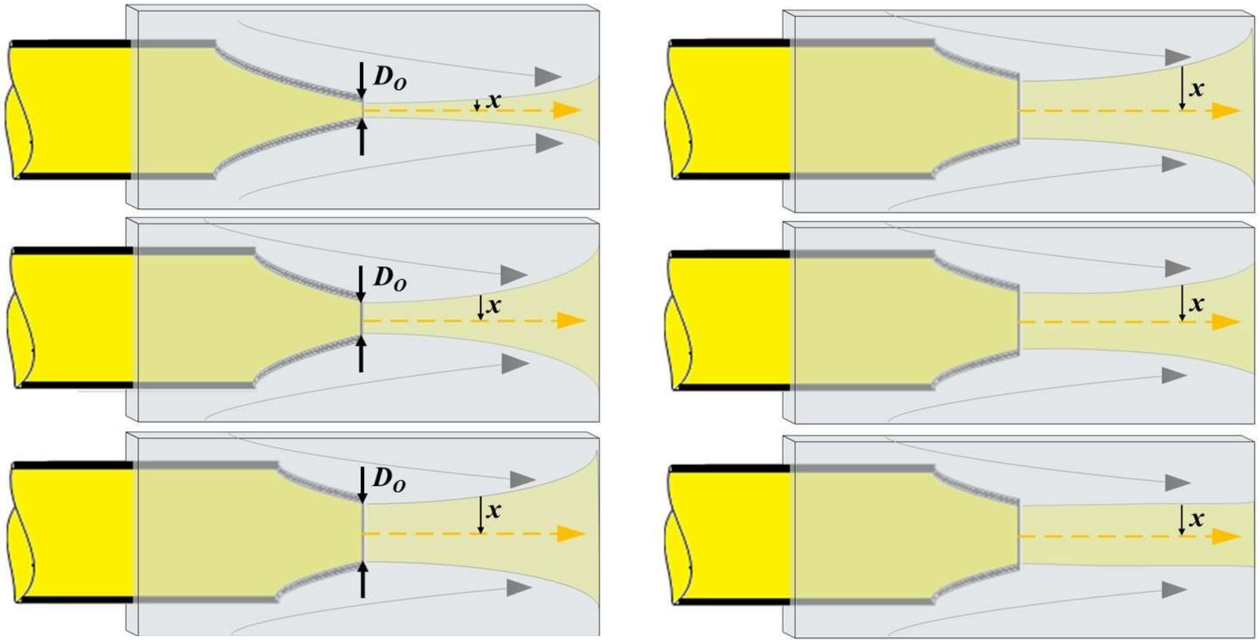
Fluid Mechanics of Nanostructured Materials, 1st SIG Meeting – QMUL – September 2017

2 phase co-flow microlfuidics



$$t = \frac{x^2}{2\mathrm{D}}$$

Where

t - average diffusion time(s) of a molecule over a distance of x (m)

D is the diffusion coefficient (m^2/s)

Found out that by decreasing the diffusion path length, diffusion time decreases which will improve the mixing due to diffusion resulting domination of nucleation in synthesis of particles, hence smaller AuNPs will be produced.

(Bandulasena, Vladisavljević, Odunmbaku, & Benyahia, 2017)

3 phase droplet based microfluidics

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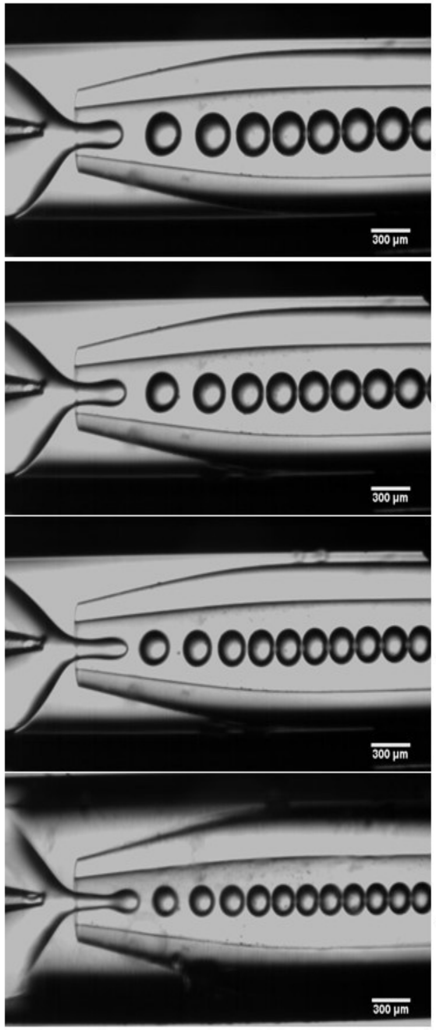
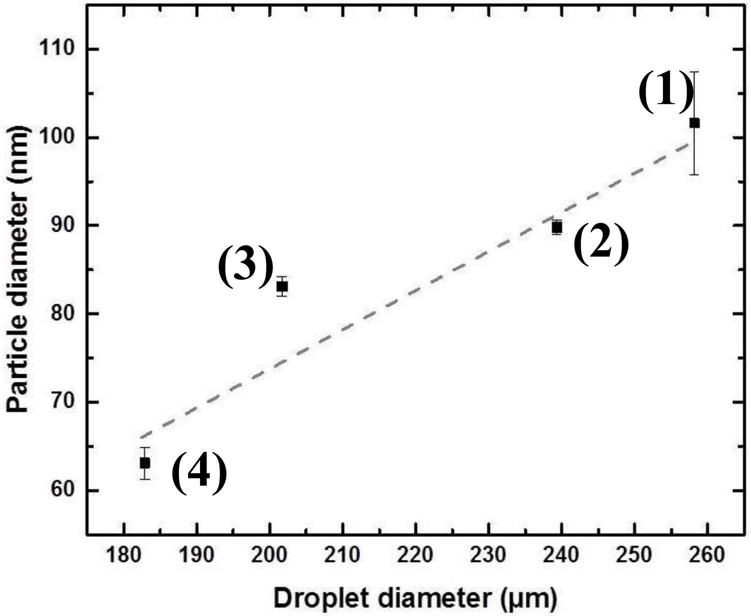


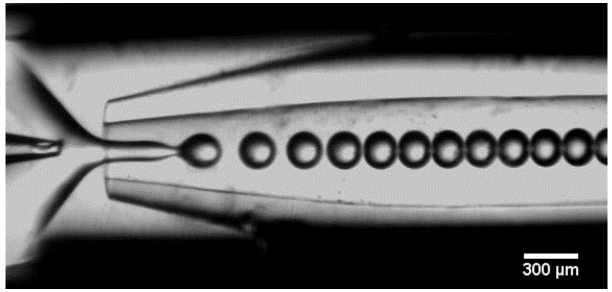
(1) $D_d = 258$ µm

(2) $D_d = 239$ µm

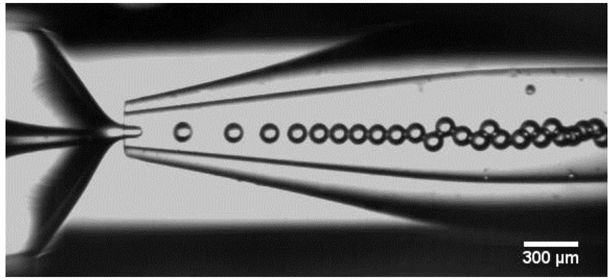
(3) $D_d = 202$ µm

(4) $D_d = 183$ µm





300 µm collection capillary



200 µm collection capillary

Found out that by changing the outer oil flow rate, size of the reaction droplet can be manipulated to improve the vigorous mixing inside the droplet resulting complete synthesis of particles before collection, hence smaller AuNPs will be produced.

Improvements to the device

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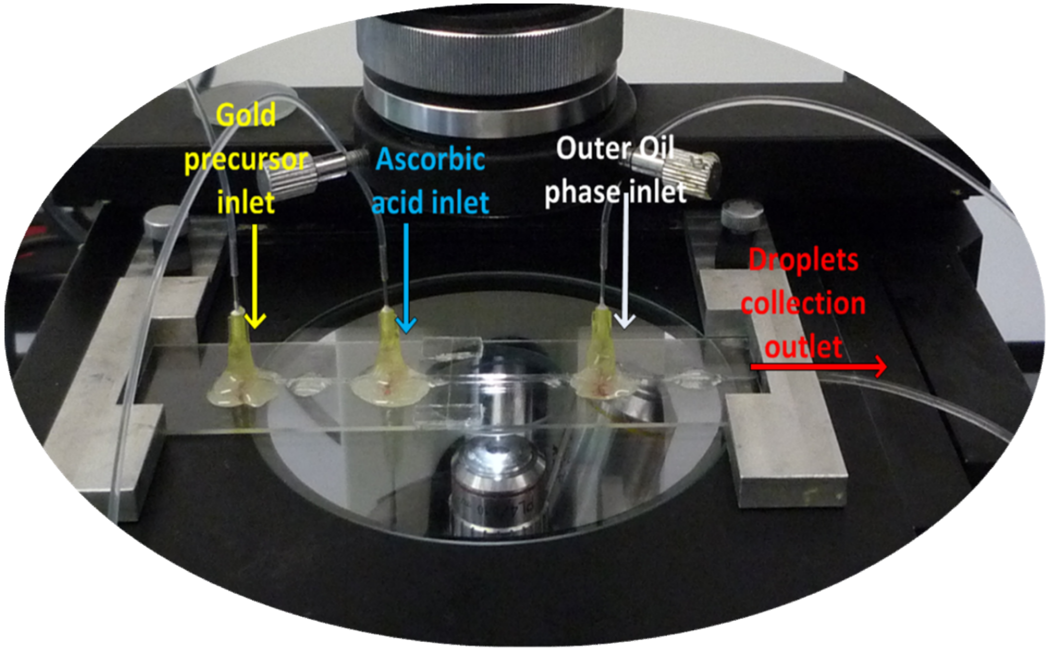

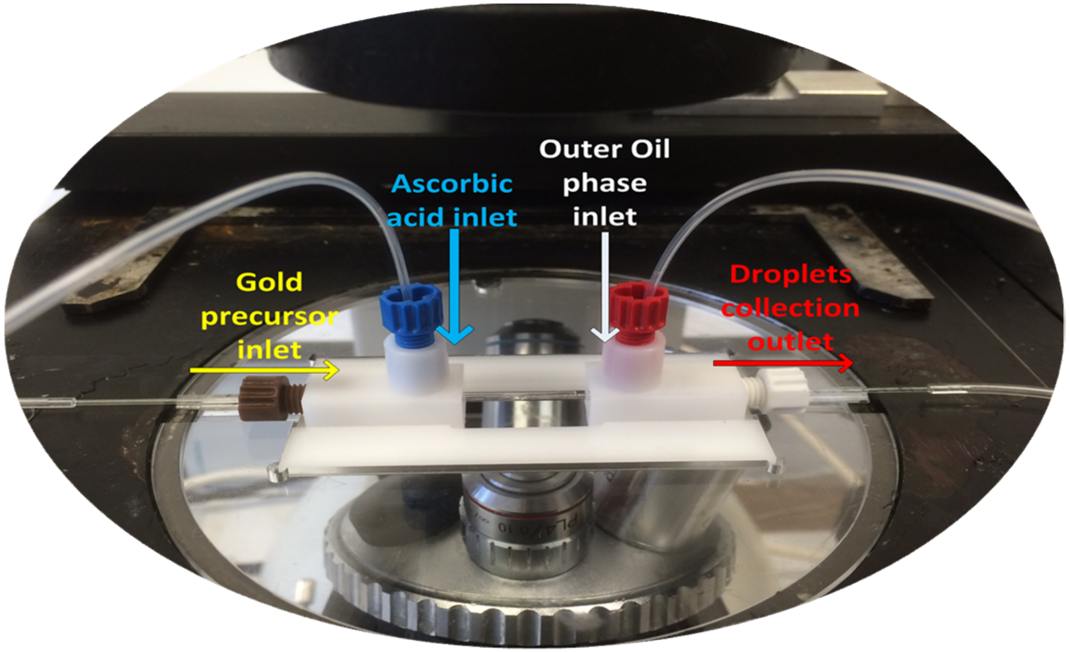

- Single use disposable microfluidic device
- Cost effective
- Time consuming fabrication
- Difficult to scale up

- Interchangeable flow geometry
- Easy to assemble and disassemble
- Easy cleaning and multiple use
- Cheaper and easier device fabrication
- Potential for scale up

(Nabavi, Vladisavljević, Bandulasena, Arjmandi-Tash, & Manović, 2017)

Future work

Drug delivery

- One step synthesis of pH responsive drug encapsulated AuNPs using reaction droplet glass capillary microfluidic device
- Drug release studies

Computational fluid dynamics

- Optimise mixing in droplets generated in glass capillary microfluidics

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Bandulasena, M. V., Vladisavljević, G. T., Odunmbaku, O. G., & Benyahia, B. (2017). *Continuous synthesis of PVP stabilized biocompatible gold nanoparticles with a controlled size using a 3D glass capillary microfluidic device*. Chemical Engineering Science, 171, 233–243.

Nabavi, S. A., Vladisavljević, G. T., Bandulasena, M. V, Arjmandi-Tash, O., & Manović, V. (2017). *Prediction and control of drop formation modes in microfluidic generation of double emulsions by single-step emulsification*. Journal of Colloid and Interface Science, 505, 315–324.

Thank you