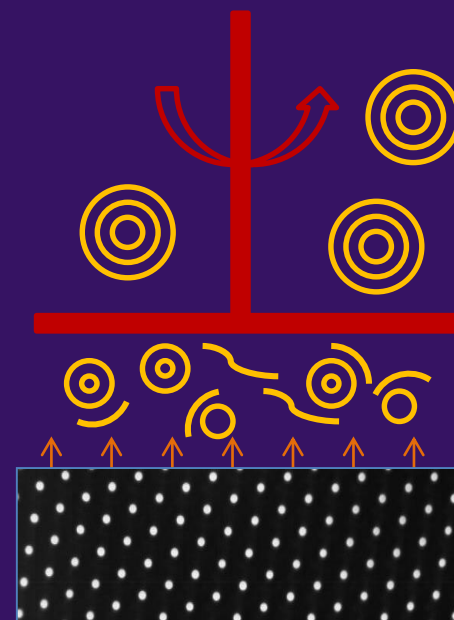




# PREPARATION OF NANOLIPOSOMES AND NANOCRYSTALS USING MICROFLUIDIC STRATEGIES

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Department of Chemical Engineering



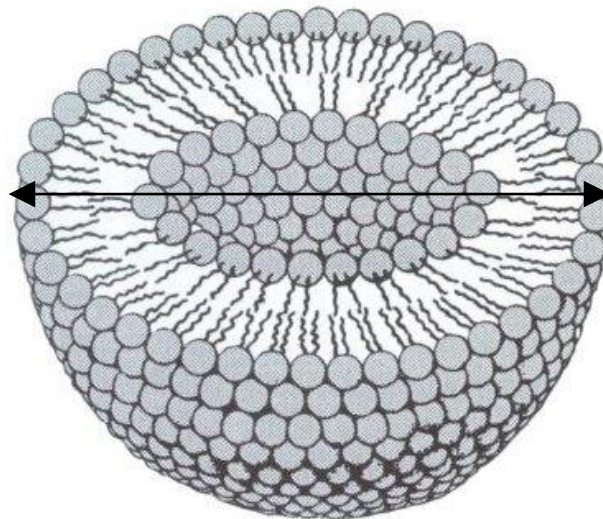
# Liposomes and nanocrystals



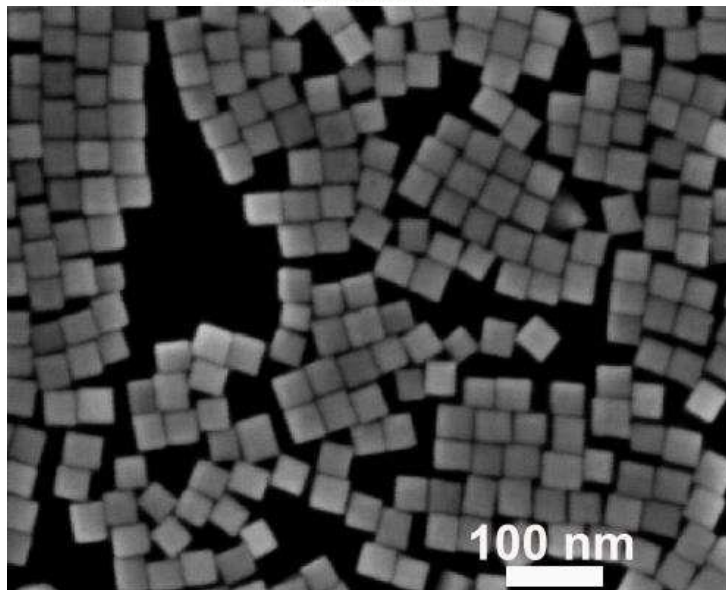
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- Liposomes are spherical nanostructures composed of single or multiple concentric bilayers resulting from the self-assembly of **phospholipids** in an aqueous solution.
- Nanocrystal is a crystalline particle having at least one dimension smaller than 500 nanometres and composed of atoms in either a single- or poly-crystalline arrangement.

80-200 nm



Liposome vesicle



Nanocrystals

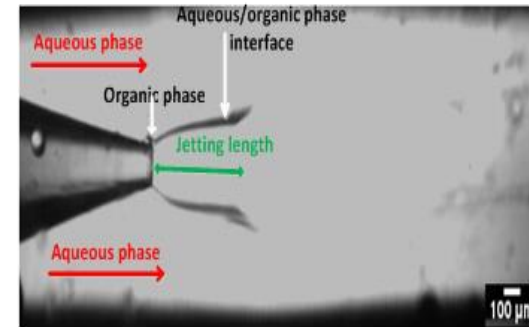
(credit: Bardhan laboratories)

# Microfluidic generation of hydrocortisone nanocrystals

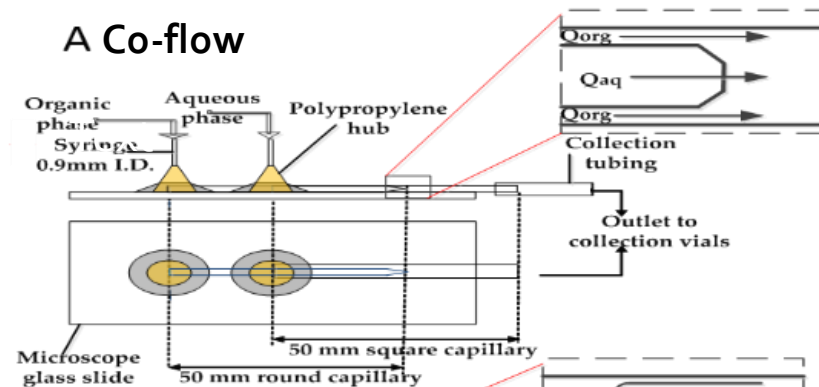


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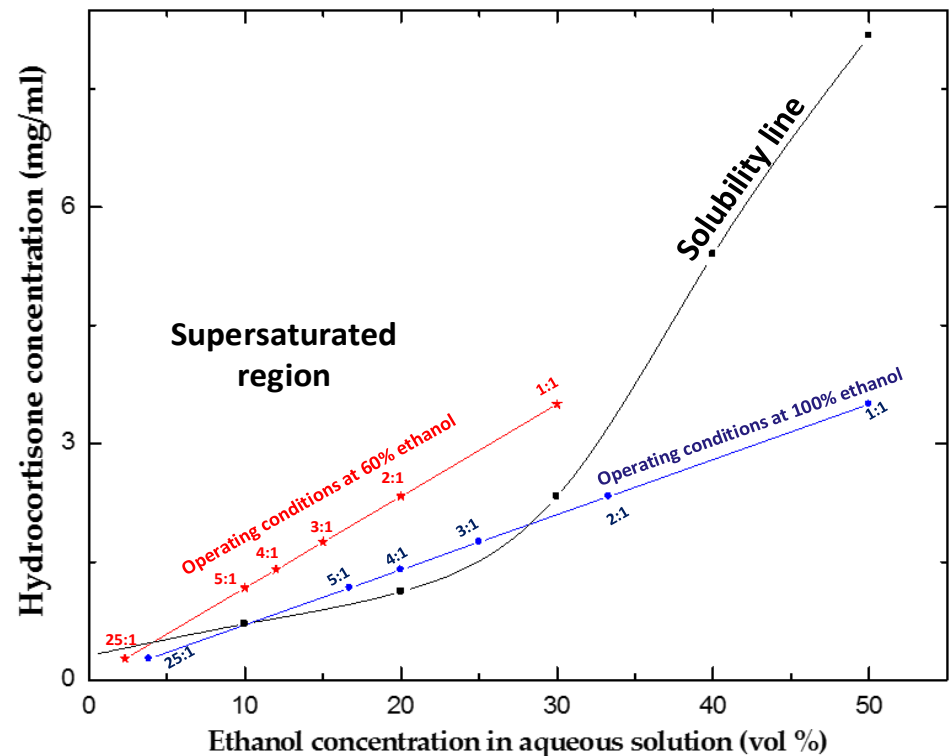
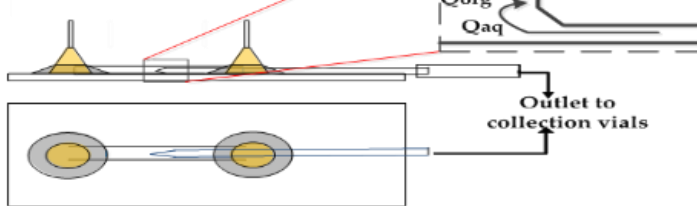
- Organic solution: 7 mg/ml hydrocortisone in ethanol/water mixture
- Anti-solvent: Milli-Q water with collection in a cocktail of stabilisers – Polyvinyl pyrrolidone (0.2g/ml); Sodium dodecyl sulfate (0.05g/ml); and Hydroxypropylmethyl cellulose (0.2g/ml)



## A Co-flow



## B Counter-current flow

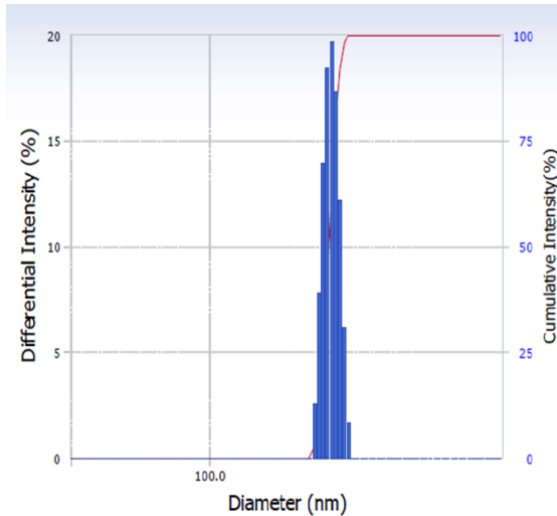


# Size control and characterisation of hydrocortisone nanocrystals

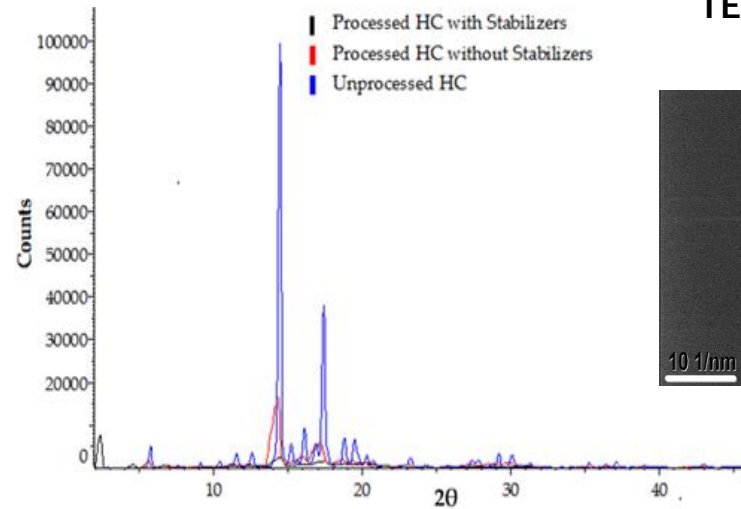


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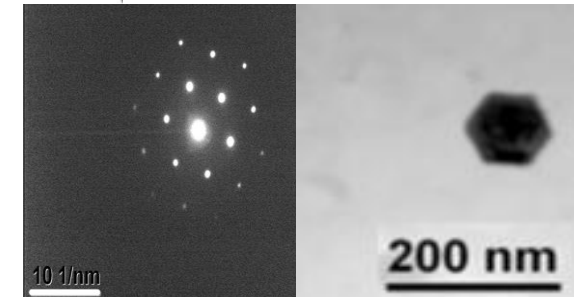
Size distribution of nanocrystals



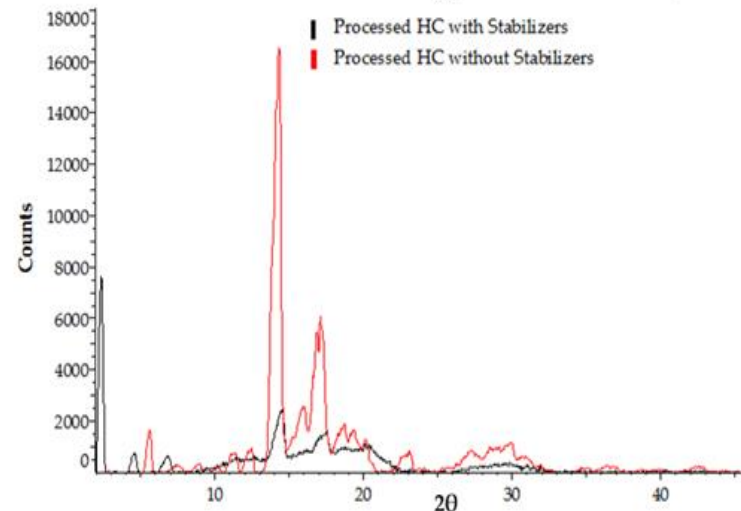
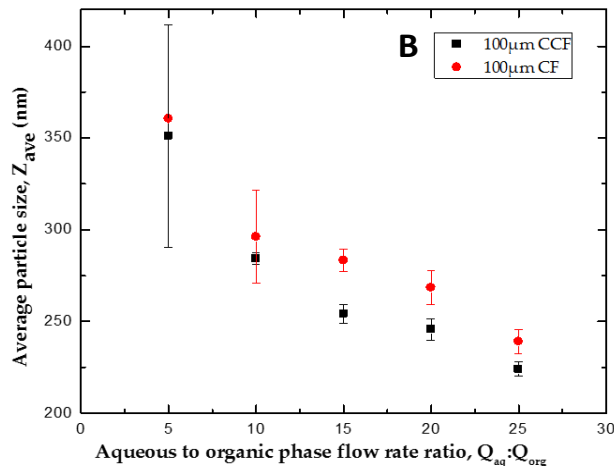
XRPD profiles of processed nanocrystals



TEM images of hydrocortisone nanocrystal



Size distribution of nanocrystals in Co-Flow and Counter-Current Flow devices



Odetade, D. & Vladislavjevic, G.T., 2016. Microfluidic Fabrication of Hydrocortisone Nanocrystals Coated with Polymeric Stabilisers. *Micromachines*, 7(12), p.236.

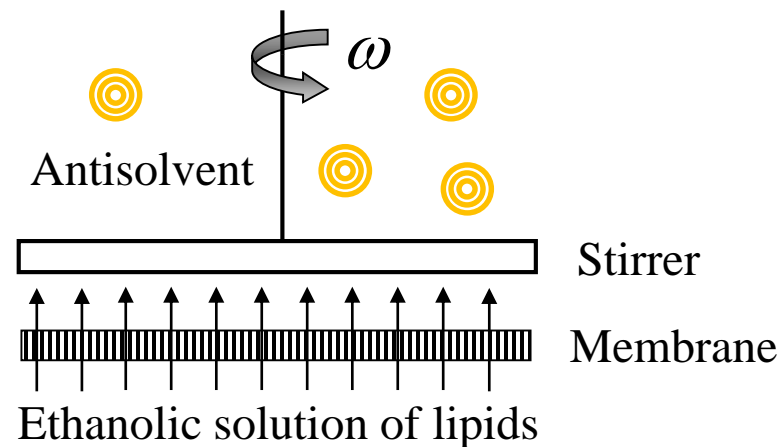
# Microengineered nickel membranes and device used



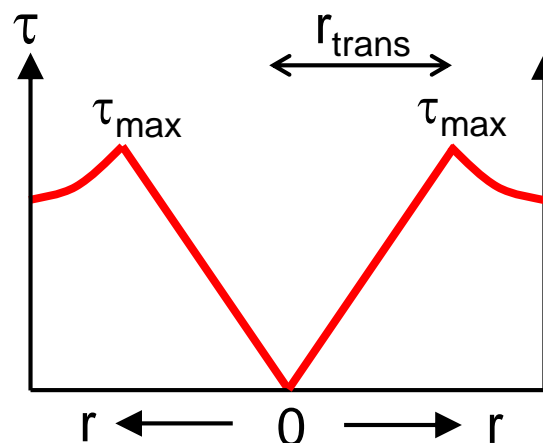
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- (a)  $L = 200 \mu\text{m}$        $d_p = 40 \mu\text{m}$
- (b)  $L = 80 \mu\text{m}$        $d_p = 20 \mu\text{m}$
- (c)  $L = 200 \mu\text{m}$        $d_p = 10 \mu\text{m}$



Shear distribution on membrane surface



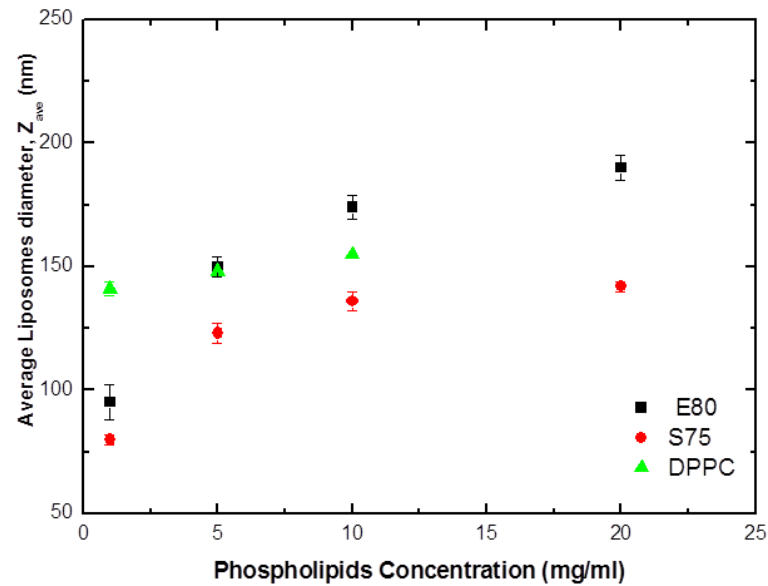
Maximum surface shear:

$$\tau_{\max} = \frac{0.825\eta_{aq}\omega r_{trans}}{\sqrt{\eta_{aq}/(\rho_{aq}\omega)}}$$

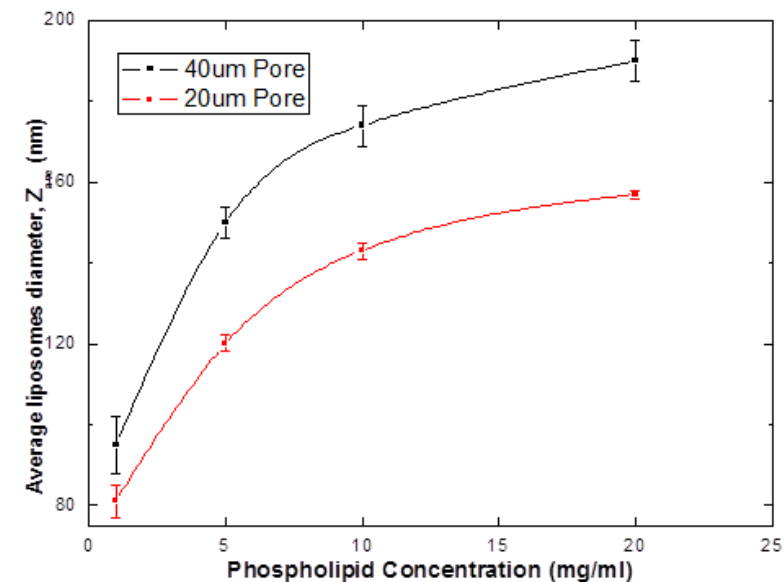
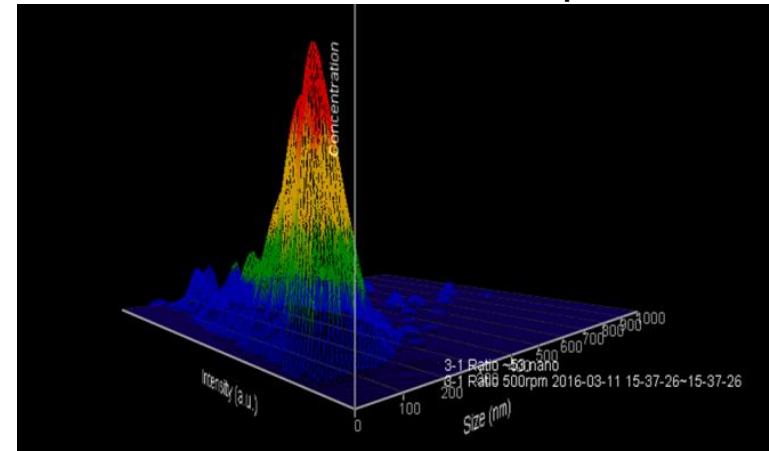
# Characterisation of nanoliposomes



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Size distribution of nanoliposomes



CryoTEM of Drug-free vesicles    CryoTEM of drug-loaded vesicles

