

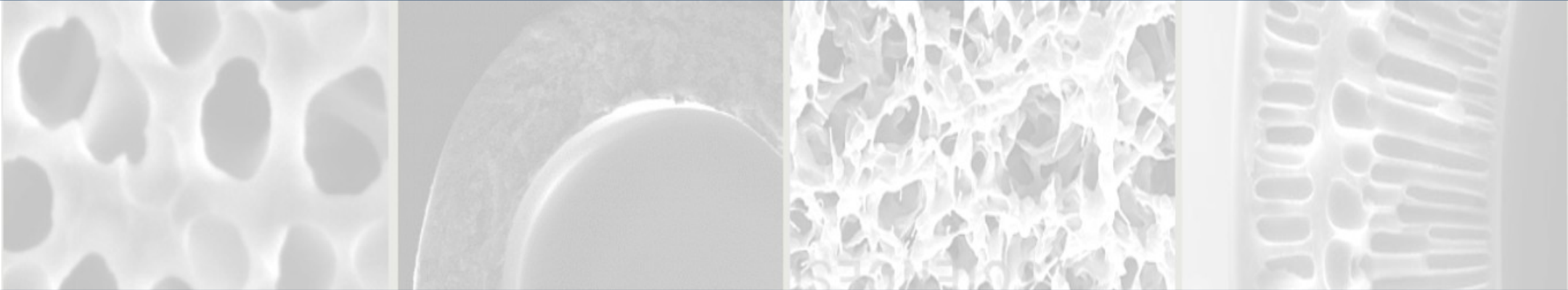


Istituto per la Tecnologia
delle Membrane
Consiglio Nazionale delle Ricerche

NUTRAGE: Opportunità & Innovazione

16 - 17 maggio 2024

Area della Ricerca di Palermo

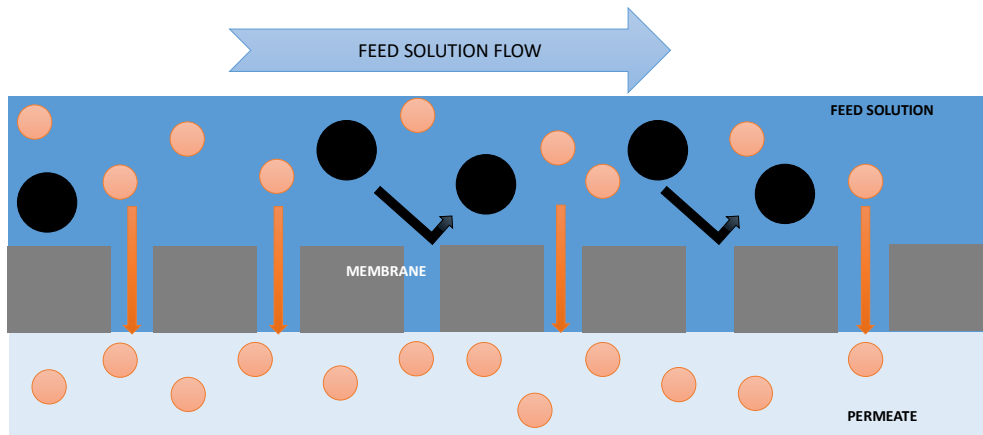


Development of uniform micro/nanocapsules based on biopolymers using green membrane dispersion processes for the encapsulation of bioactive molecules

**Emma Piacentini, CNR-ITM
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Particles Manufacturing by Membrane Technology

Separations by membrane operations



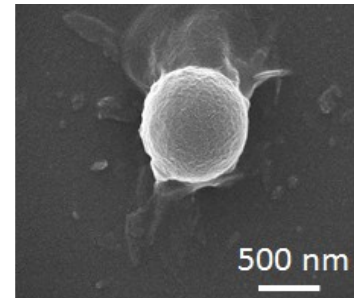
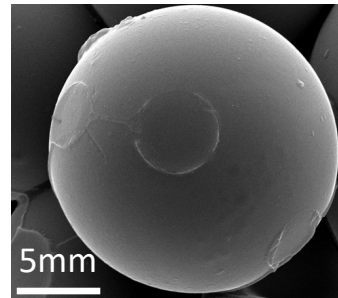
Membrane Emulsification

Micro-nanoencapsulation for food applications

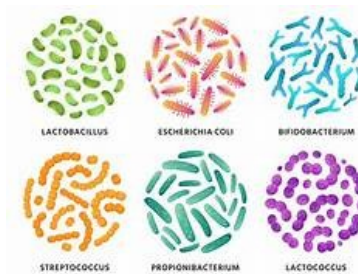
Stability

Preventing protein inactivation or denaturation.
Protect against chemical (oxidation) and physical factors (include temperature, humidity, pressure, radiation, ...)

Pigments



Proteins



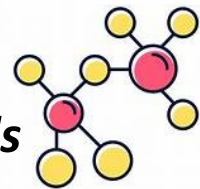
Microorganism

Probiotics
Bacteriostatic agents



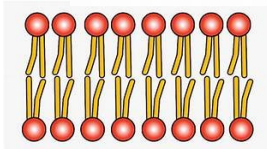
Flavor

Taste substance
Odorant



Bioactive compounds

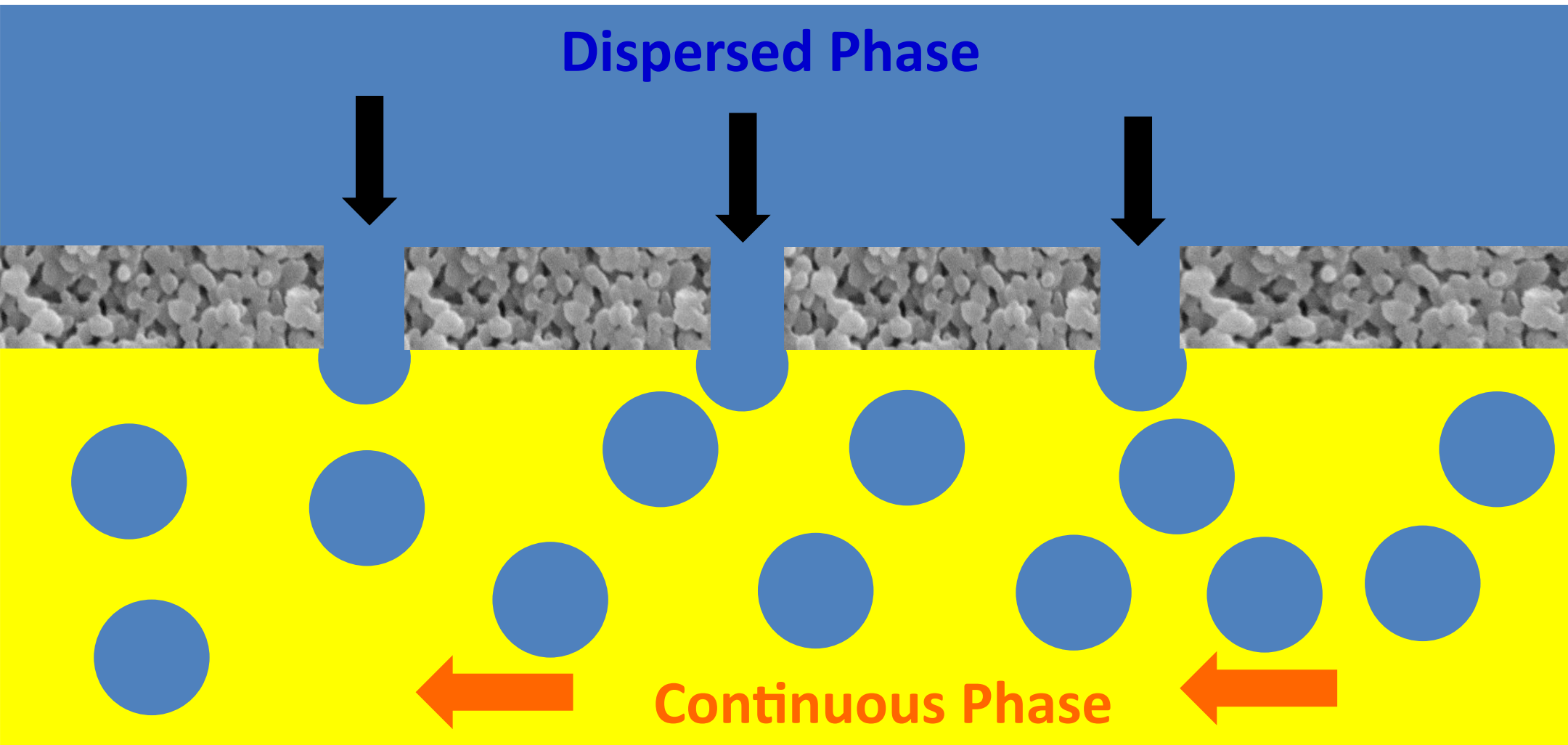
Lipids



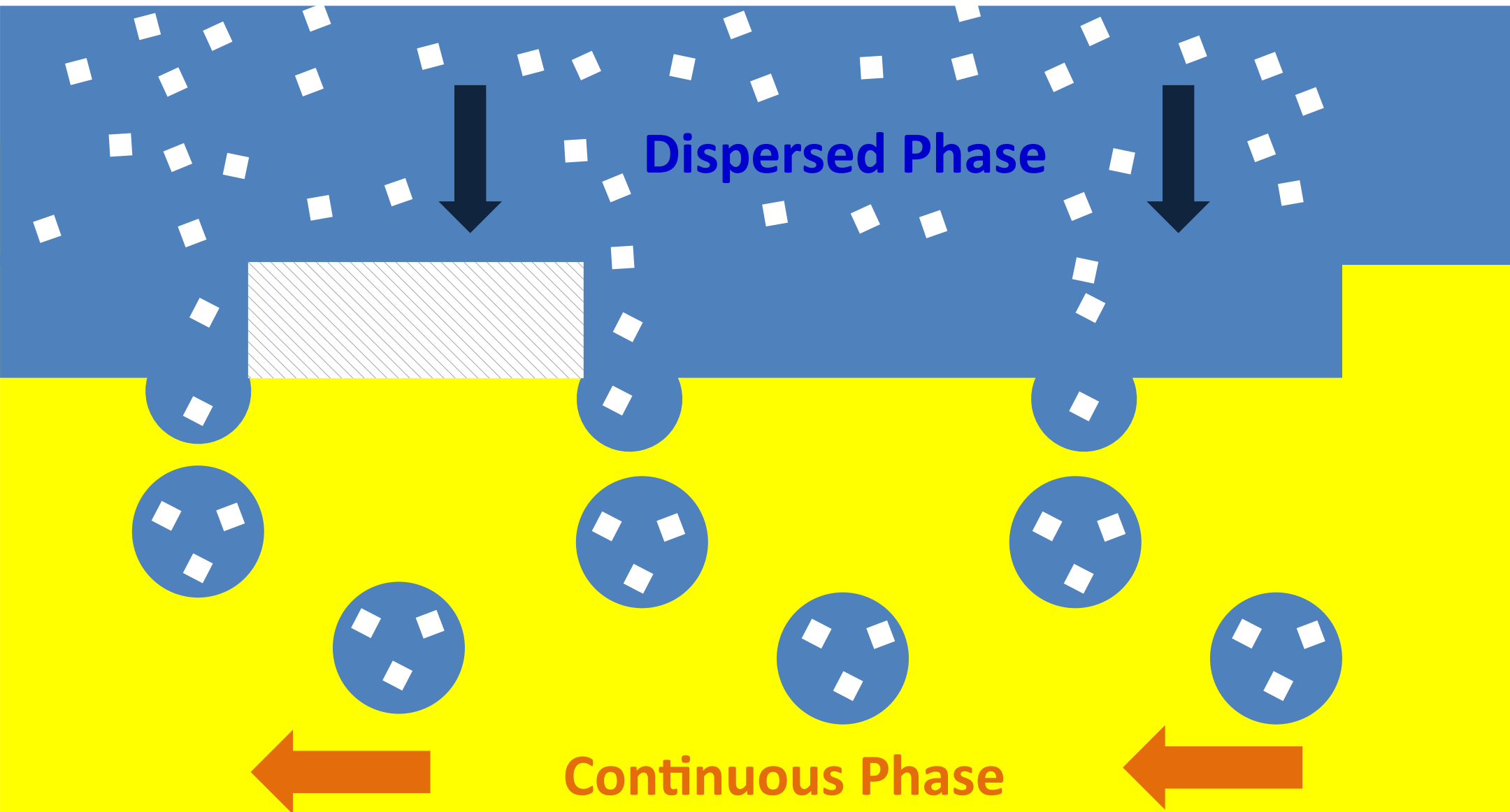
Delivery

to ensure the precise delivery of the right amount of material to the right place at the right time, thereby increasing substance utilization efficiency, improving efficacy, and reducing costs.

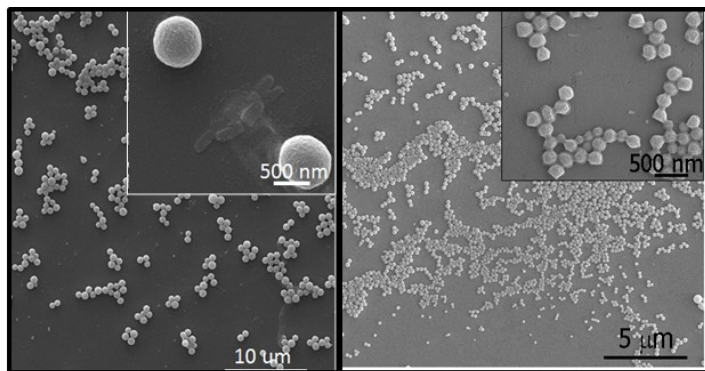
Membrane Emulsification



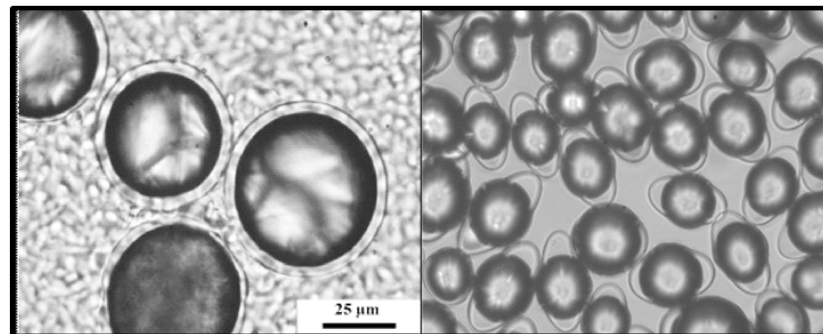
Bioactive molecules Encapsulation



Particles Production

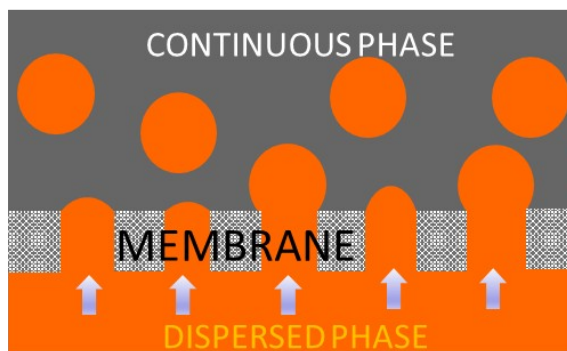


NANOPARTICLES

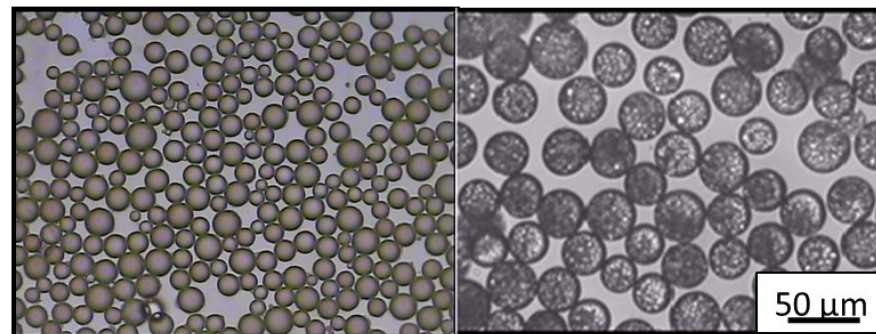
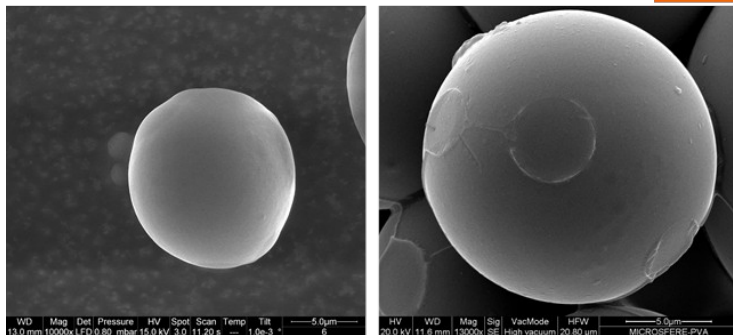


CORE-SHELL PARTICLES

MICROPARTICLES

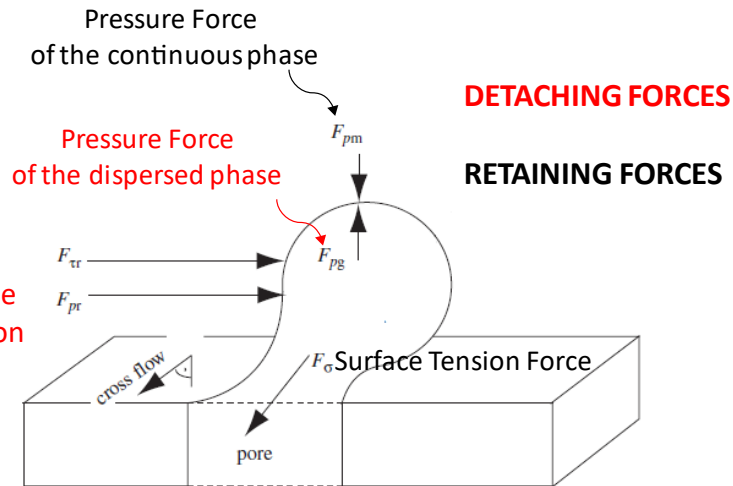


SIMPLE AND MULTIPLE EMULSIONS



Encapsulation by Membrane Emulsification: Why ?

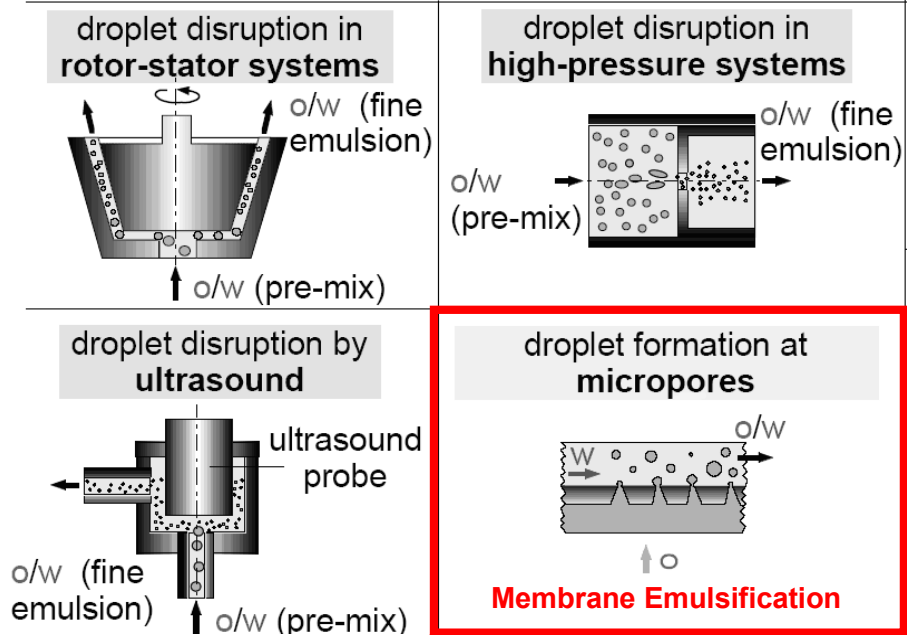
LOW SHEAR PROCESS



Wall Shear Stress : $1-10 \times 10^3 \text{ s}^{-1}$

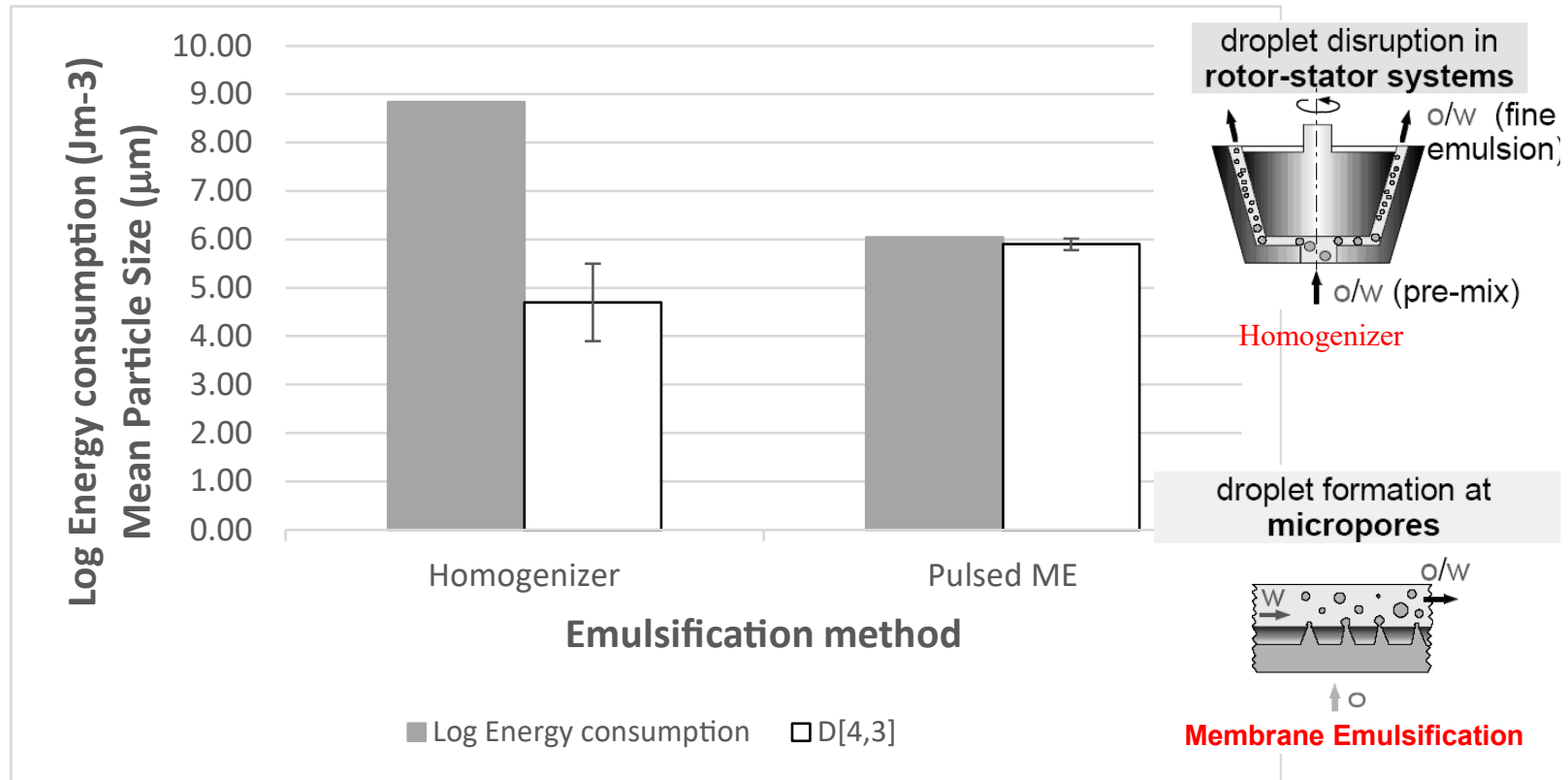
LOW ENERGY PROCESS

mechanical processes



Energy Consumption: $10^3-10^6 \text{ Jm}^{-3}$

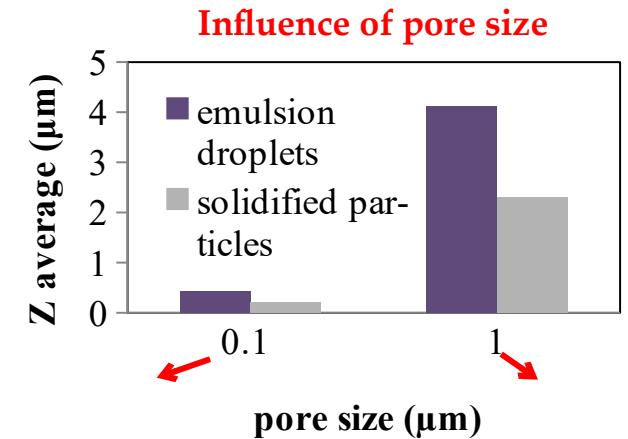
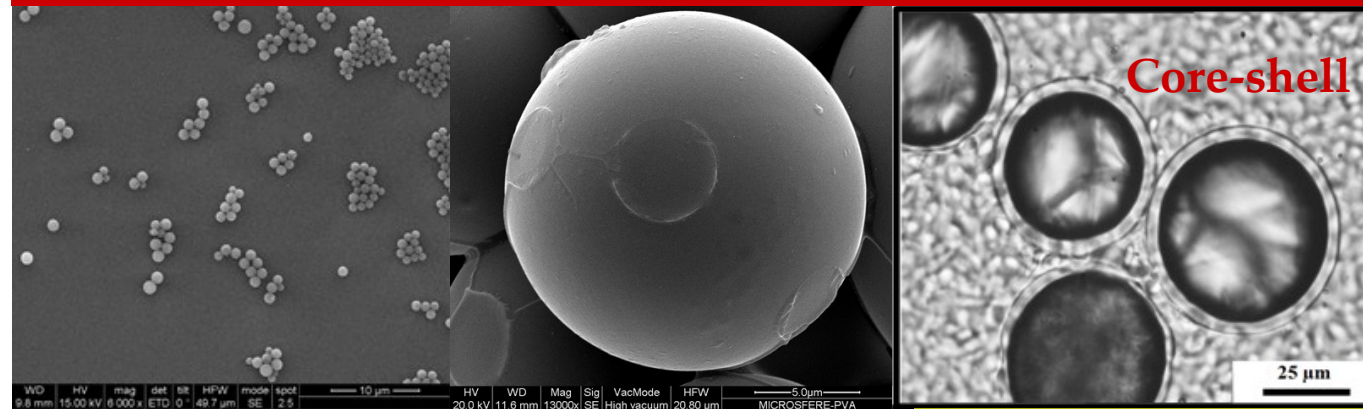
Low Energy Consumption



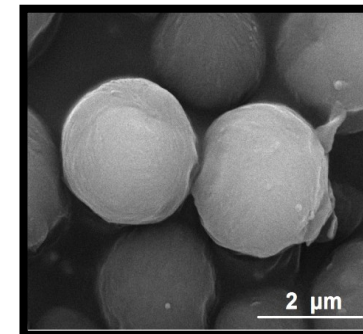
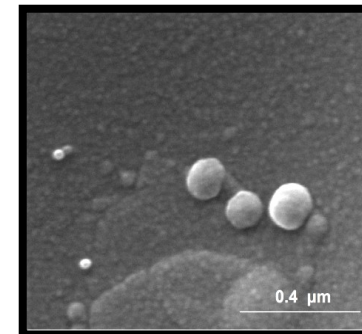
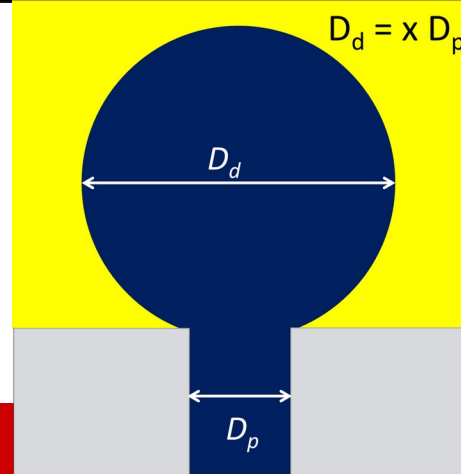
Encapsulation by Membrane Emulsification: Why ?

PRECISELY CONTROLLED PARTICLE SIZE, SIZE DISTRIBUTION AND STRUCTURE

Microparticles



Matrix

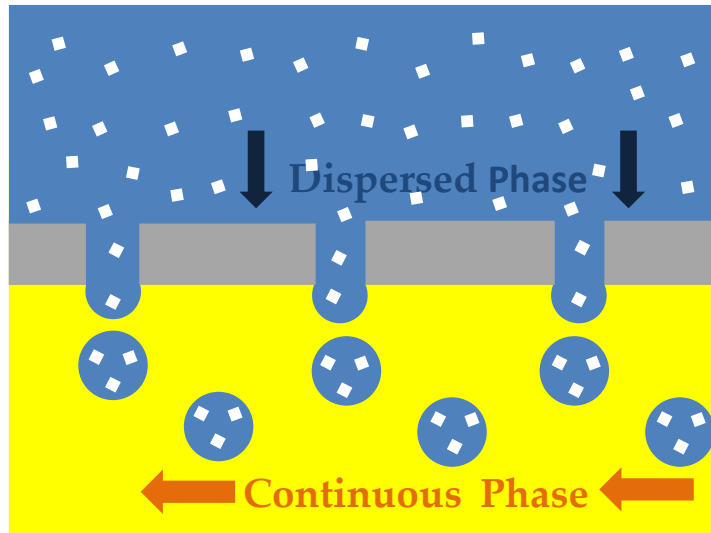


Nanoparticles

A. Imbrogno, **E. Piacentini**, E. Drioli, L. Giorno, Micro and nano polycaprolactone particles preparation by pulsed back-and-forward cross-flow batch membrane emulsification for parenteral administration, International Journal of Pharmaceutics, 477 (2014) 344-350

Encapsulation by Membrane Emulsification: Why ?

MAXIMIZE MASS UTILIZATION AND REDUCE WASTE PRODUCTION



Encapsulation efficiency $\approx 100\%$

EASY SCALABILITY



Filter Kit
(V= 6-8 mL)

Cross-flow membrane emulsification plant
(V= 300 mL- Several liters)



SPG Technology (Japan)

Conclusions

