

# Oscillating Membrane Emulsification for controlled droplet production

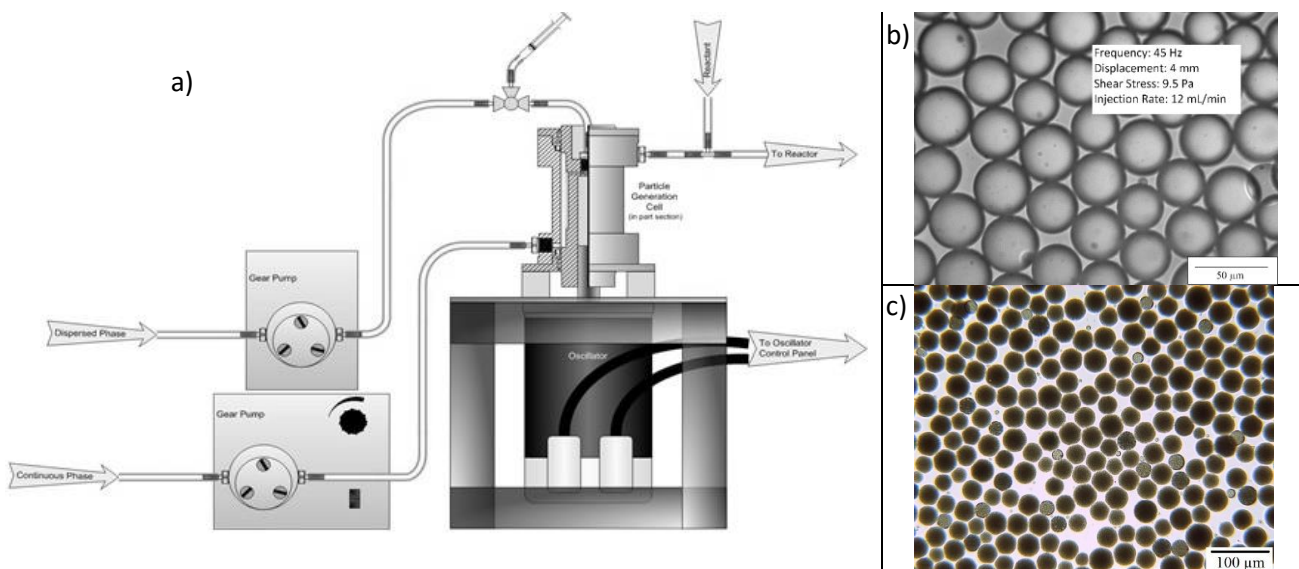
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Membrane emulsification holds a great interest for industrial use in particle production, especially for production of “high technology” products and uses, for example in chromatography resins, medical diagnostic particles, drug carriers, food or flavour encapsulation [1]. A novel membrane emulsification system is reported consisting of a tubular metal membrane, periodically azimuthally (tangentially) oscillated with frequencies up to 50 Hz and 7 mm displacement in a gently cross flowing continuous phase. A CFD analysis showed consistent axial shear at the membrane surface, which became negligible at distances from the membrane surface greater than 0.5 mm. For comparison, CFD analysis of a fully rotating membrane emulsification system showed local vortices in the continuous phase leading to a variable shear along the axis of the membrane. Oil-in-water (o/w) emulsions were experimentally produced with a median diameter of 20-120  $\mu\text{m}$ , and a coefficient of variation of droplet size of 8%. The drop size was correlated with shear stress at the membrane surface using a force balance. In a single pass of continuous phase, it was possible to achieve high dispersed phase concentrations of 40% v/v [2]. Uniform complex emulsion production, such as water-in-oil-in-water (w/o/w), is also reported using a different membrane emulsification device: Micropore Dispersion Cell [1]. Overall, this work enhances ME technology, showing its ability of control droplet size and size distribution, easy of scalability, and efficiency relatively to waste product generation and energy input.



**Figure 1.** a) Schematic illustration of the Oscillating Membrane Emulsification (OME); b) o/w uniform emulsion using OME; c) w/o/w uniform (double) emulsion using dispersion cell [1].

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- [1] Stillwell, M.T., R.G. Holdich, S.R. Kosvintsev, G. Gasparini, and I.W. Cumming, *Stirred cell membrane emulsification and factors influencing dispersion drop size and uniformity*. Industrial & Engineering Chemistry Research, 2007. **46**(3): p. 965-972.
- [2] Silva, P.S., M.M. Dragosavac, G.T. Vladislavljević, H.C.H. Bandulasena, R.G. Holdich, M. Stillwell, and B. Williams, *Azimuthally oscillating membrane emulsification for controlled droplet production*. AIChE Journal, 2015. **61**(11): p. 3607-3615.