Uniform Biodegradable Microspheres: A Membrane-Assisted Solvent-Evaporation Technique

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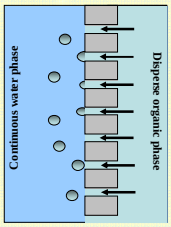
Motivation

- Polymer microspheres are to be used for medical application
  - Intravenous injection
  - Magnetic microspheres
- Size and dispersion are important
  - 1 micron particle size required for capillary transport
  - Monodisperse particles are necessary for control of kinetics of drug release or toxin uptake

Membrane Emulsification

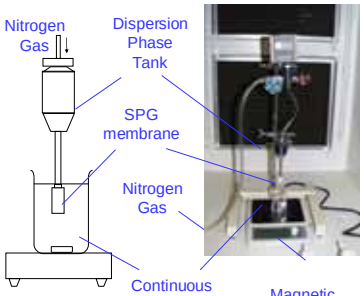
- Membrane replaces stirring and sonication
- Produces monodisperse particles by controlling emulsification
- Pore size determines particle size



Microsphere Synthesis

- Dispersed phase is a polymer in organic solvent; initial experiments involve poly (L-lactide) in dichloromethane.
- Continuous phase is water with an ionic surfactant, currently SDS (sodium dodecyl sulfate). PVA (poly vinyl alcohol) is sometimes used as an additional surfactant.
- The dispersed phase is forced through the porous membrane by nitrogen gas at 5-80 kPa, while the continuous phase is stirring. The solution is stirred until the organic solvent is removed from the microspheres.

Internal Micro-Kit, SPG Technologies



Membrane Mounts

SPG

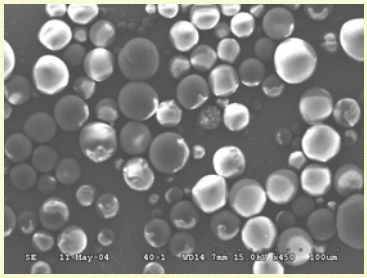
Poretics®

- Problems with the Micro Kit include difficulty in fitting the membrane to the mount, leading to potential damage to the membrane. This could lead to large jets of polymer.
- An alternative membrane system using a Poretics® filter mount is being investigated.

Results

- Initial experiments use poly (L-lactide) as the polymer
- Particles are not yet monodisperse
- Parameters to be investigated for optimization of microsphere production:
  - Surfactant
  - Solvent
  - Temperature
  - Emulsification rate
  - Stirring speed
  - Solvent removal technique

Poly (L-lactide) Microspheres



Continuing Work

- After optimization of the method using poly (L-lactide), microspheres containing other polymers will be produced. Inclusion of magnetic particles into the polymer microspheres will be pursued.
- The membrane-assisted solvent-evaporation technique will allow production of high-quality polymer microspheres for medical applications.

Collaborative Investigators for Applied Nanotechnology in Medicine

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