

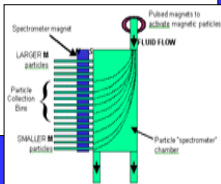
# Fluorescent-Magnetic Microspheres for Improved Bioassay Techniques

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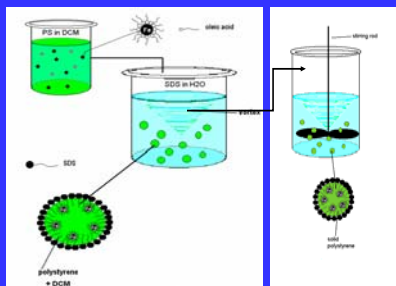
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## Motivation

- Flow cytometry is a technique used to sort DNA and cells for analysis. Fluorescent spheres are functionalized to attach to specific molecules and then optically sorted.
- Parallel molecular analyses are needed to maximize speed of results. Traditional technique allows  $\sim 10^2$  simultaneous analyses.
- Incorporating ferro-magnetic nanoparticles in fluorescent polymer spheres may increase the number of analytes to  $\sim 10^4$



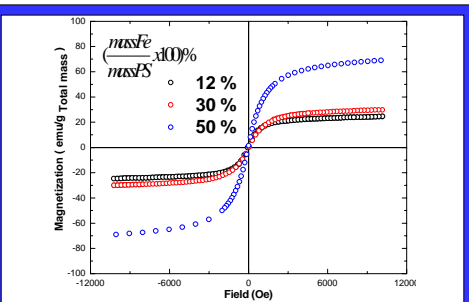
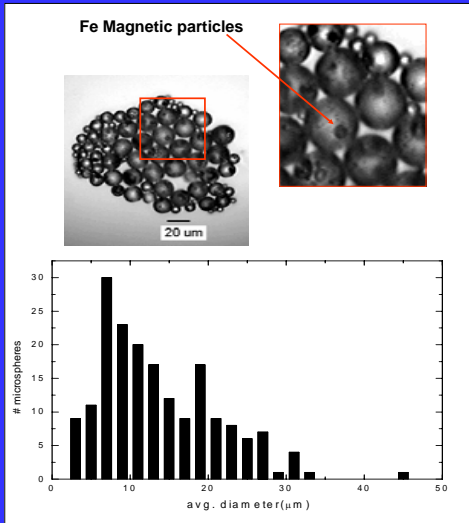
## Sample Fabrication



- Fe milled 28 hours with Oleic Acid, added to solution of Polystyrene (PS) dissolved in Dichloromethane (DCM)
- Mixture added to a solution of Sodium Dodecyl Sulfate (SDS) in water and vortexed to make emulsion
- Solution is continuously stirred, allowing the DCM to dissolve out of the spheres
- Result is nanoparticulate iron embedded in solid PS spheres that are made hydrophilic by the SDS

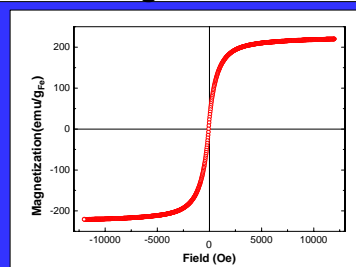
## Structural and Magnetic Properties

### Light Microscopy



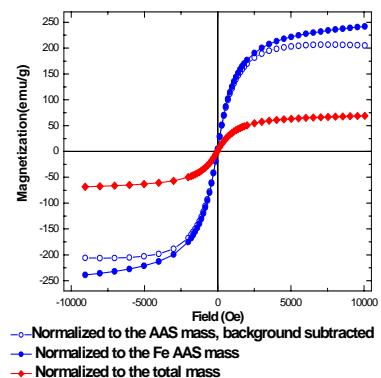
$M_s$  increases as wt.% of Fe compared to polystyrene increases

### Magnetization



- Fe + Oleic Acid milled 28 hours.
- $M_s = 218 \text{ emu/g}_{Fe}$
- Magnetic measurements were normalized to the Fe mass as determined by AAS

### Fe particles encapsulated in PS spheres



- Amount of Fe compared to polystyrene is 50 wt.%
- $M_s$  of Fe is  $\sim 206 \text{ emu/g}_{Fe}$
- $M_s$  of microspheres is  $\sim 70 \text{ emu/g}_{Total \text{ mass}}$

## Conclusions

- Approximately 80% of spheres are below 20  $\mu\text{m}$  diameter; however, a narrower size distribution with maximum slightly less than 8  $\mu\text{m}$  is desired.
- $M_s$  for microspheres increases with increase in wt.% Fe compared to polystyrene. A high  $M_s$  is desired to effectively detect the magnetic moment of the spheres.
- $M_s$  for iron in microspheres (206  $\text{emu/g}_{Fe}$ ) approaches bulk value even after encapsulation into polystyrene. This indicates iron has not oxidized.
- $M_s$  for microspheres is  $\sim 70 \text{ emu/g}_{Fe}$  when weight percentage of Fe to polystyrene is 50%.

## Future Directions

- Increase wt. % of Fe compared to polystyrene
- Incorporate hard magnetic material in order to increase remnance magnetization
- Narrow size distribution
- Functionalize particles for bioassay technique

## Acknowledgements

T. Jain  
(University of Nebraska Medical Center)  
K. Warren  
(University of Nebraska - Lincoln)