SPRING SEMESTER COURSE (2009)

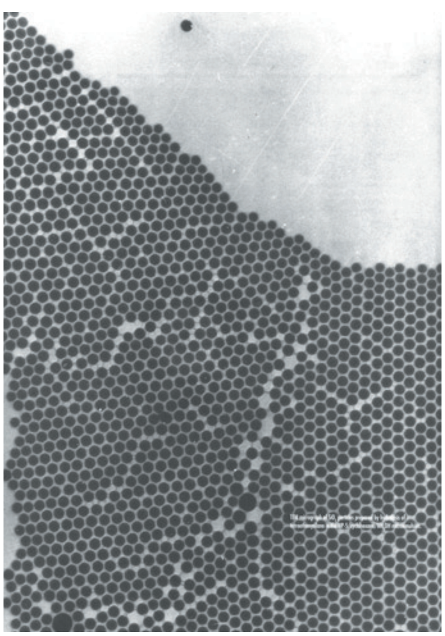
HYDROMETALLURGICAL PROCESSES

MatSE 560

1:00-2:15 Tuesday/Thursday – 316 HHD East

COURSE DESCRIPTION

This 3-credit course is concerned with the **fundamental physico-chemical processes associated with the processing, utilization, and recycling of materials in aqueous systems**. The topics covered cut across a wide range of practical applications. The course is therefore suitable for a broad spectrum of scientists and engineers concerned with processes and processing in aqueous systems, e.g., **in materials science and engineering, energy and geo-environmental engineering, geosciences, soil science, civil and environmental engineering, chemistry, chemical engineering, mineral processing, petroleum and natural gas engineering, mining engineering, nuclear engineering, and electronic and electrical engineering**. A required term paper provides a formal mechanism for ensuring that students have the opportunity to apply ideas discussed in the course to their specific areas of interest.



Silica particles synthesized in a water-in-oil microemulsion.

TOPICS

1) Thermodynamics of Electrolyte Solutions - Estimation of thermodynamic data for aqueous species; activity coefficients in concentrated solutions; prediction of high temperature stability constants for metal-ligand complexes.

2) Graphical Representation of Hydrochemical Equilibria - Solid/solution equilibria; thermodynamic criteria for calculating aqueous stability diagrams (e.g., Eh-pH (Pourbaix), log{Ligand}-pH, log{M}-pH); speciation diagrams; computer techniques.

3) Rate Processes - Mathematical representation of rate laws; kinetics and reaction mechanisms; ligand substitution and electron transfer reactions in homogeneous systems; transport processes and heterogeneous chemical reactions; metal and semiconductor electrode kinetics; mathematical modeling.

4) Dissolution, Crystallization, and Precipitation Processes - Rates and mechanisms of dissolution, crystallization/precipitation reactions; transport, interfacial and electrochemical phenomena; solid-state and solution chemical considerations; the semiconductor/electrolyte interface; complexation and colloid stability; sols, gels, nanoparticles; microbially mediated processes.

5) Organic/Aqueous Systems - Nonaqueous solvents, adsorption and ion-exchange phenomena, ion transfer across the organic/aqueous interface and through membranes; reversed micelles and microemulsions; materials synthesis via hydrolysis and precipitation in organic solvents; alkoxide systems; chelation.

6) Applications - e.g., Materials synthesis: nanomaterials, thin films; suspension and colloidal processing; aqueous chemical processing in semiconductor device manufacturing; chemical-mechanical polishing; preparation of catalysts; electroplating and electroless plating; battery/fuel cell materials and reactions; electromachining; solar energy conversion; hydrometallurgical extraction; environmental hydrometallurgy; heavy metal removal from industrial wastewaters; leaching of nuclear waste; boiler water treatment and steam generator chemistry; scale control by inhibited precipitation; oil field aqueous chemistry; solution mining; dissolution, adsorption and precipitation processes in natural water systems.

TEXT - K. Osseo-Asare, Chemical Principles in Aqueous Processing (Lecture notes).

INSTRUCTOR - K. Osseo-Asare - 208 Steidle Building; 865-4882
asare@ems.psu.edu
http://www.matse.psu.edu/people/faculty/osseo-asare.html
http://www.ceka.psu.edu
http://www.matse.psu.edu/news/news_osseo_asare_nae.html
http://www.elsevier.com/locate/hydromet

For further information, please contact instructor.