# Hybrid Latex Systems – PU/Acrylic, Alkyd/Acrylic and Inorganic/Organic Latices

Day 1

AM:
- Basics of emulsion polymerization
- Particle size control
  Copolymer composition control
- Colloidal stability
- Dispersion rheology
- Mini-emulsion polymerization techniques
- Introduction to Pickering Emulsions
- Characterization of latices and other dispersions

PM: **Organic/inorganic hybrid particles**

- Why incorporate inorganics into latex particles?
- Morphological control (thermodynamic vs. kinetic)
- Making organic/inorganic hybrid particles
  - Emulsion polymerization
  - Mini-emulsion polymerization
  - Dispersion polymerization
  - Heterocoagulation

- Various organic/inorganic hybrid particles
  - Polymer/silica hybrid particles
    - ✓ Core-shell particles
    - ✓ Pickering stabilization
- Polymer/clay hybrid particle
    - ✓ Clay encapsulation
    - ✓ Clay-armored latex particles
- Polymer/CNT hybrid particles
- Magnetic hybrid particles
- Other organic/inorganic hybrid particles
    - ✓ Stimuli-responsive organic/inorganic hybrid particles
    - ✓ Polymer/metal hybrid particles

- Film formation of organic/inorganic hybrid particles
- Properties of coatings from organic/inorganic hybrid particles

Day 2

AM: **Alkyd/Acrylic Latex Particles**

- What is an alkyd/acrylic hybrid? How is it different than other polymer/polymer hybrids?
- Incentives for an alkyd/acrylic hybrid latex
  - synergy of properties from solvent borne and waterborne coating systems
  - no VOC
- Brief background of solvent borne alkyd coatings
- Alkyds: chemistry, structures, fatty acid constituents, double bond content & degree of unsaturation

- **Alkyd/Acrylic Hybrid Latex**
  - Hydrophobicity of alkyd precludes its use in traditional emulsion polymerization
  - Miniemulsion polymerization
    - applicability to this system and typical procedures
- Hybrid particle morphology
  - Target morphologies
  - Thermodynamic vs. kinetic control
  - Characterization
  - Challenges/constraints
- Grafting of alkyd & acrylic phases
  - Mechanisms
  - Characterization
  - Implications
- Kinetics of Acrylic Polymerization in Presence of Alkyd
  - Retardation
    - ✓ Function of type of alkyd used
  - Limiting monomer conversion
    - ✓ What is this? What levels of unreacted monomer?
    - ✓ Theories as to why this occurs in this type of system
    - ✓ Methods to overcome and finish the residual monomer
- Film formation of alkyd/acrylic latex
  - Auto-oxidative cross linking of alkyd residual double bonds with drying oils
  - No drying oil added
- Properties of alkyd/acrylic latex films

PM: **Polyurethane/Acrylic Hybrid Latex Particles**

- **Aqueous polyurethane dispersions**

- VOC driving force
- Types of PU's that are useful as PUD's
- Creating PUD's
  - Chemistry, stabilization
  - Dispersion process, particle size control
  - Use of NMP and other solvents
  - Hydrogen bonding, hard segment nano-domains
  - Water content in PU particles
- Film applications
- Coating properties

- **PU/Ac hybrid latex particles**

- Driving force
- Types of acrylics of interest
- Morphological alternatives
  - Thermodynamic control'
  - Kinetic control
- Polymerization processes
  - PUD as "seed" particles, pH control
  - Batch and semi-batch acrylic polymerization
  - Reaction kinetics, including starve fed
    - ✓ Initiator systems
    - ✓ Reaction temperature ranges
  - Establishing phase structure in PU/Ac composite particles
  - Effect of annealing
  - Hydrogen bonding issues
- Properties of composite films
  - PUD – Ac latex blends
  - PU/Ac composites