

Module 2: Shape Characterization

- A mission flight to Neptune brings back a rock sample which appears to be an agglomerate of many nano- to micron-sized inorganic particles. You are asked to characterize it:
 - How would you assess its shape using the membership-roster concept?
 - How would you measure individual particle sizes using laser-light scattering? Relate scattered light intensity to specific particle properties, and draw inferences regarding ability to measure sizes of particles in the nano-range.
 - Describe some common techniques to present particle size distributions of assemblies of particles. What are some common distributions found in nature, and their causes?
 - How would you obtain the elemental composition of the particle with some depth-profiling? What are the three distinct zones in the structure of a particle, and how would you expect the chemical composition to differ in these zones?
 - You are asked to set the particle in motion, and estimate its size based on transport characteristics. What is likely to be the most dominant transport mechanism, and what is the associated size-dependence?

- Name the four major classes of shape analysis schemes. Describe any one in detail.
- Describe the “membership roster” concept of shape assessment.
- Outline a systematic shape assessment scheme. What data would you need to decide whether a verbal descriptor for particle shape is sufficient, or whether you need a digitized profile? Illustrate with an example.
- Describe how you would perform shape, structure and size characterization for the following cases:
 - Nano-catalyst particle whose 3D surface morphology controls rate of chemical reaction
 - Pharmaceutical powder sample where flowability and settling are key characteristics
 - Particulate media used in a high-concentration polishing slurry
- What do you understand by the following terms commonly used in particle shape analysis:
 - Membership-roster concept
 - Common feature concept
 - Clustering concept

Where would “fuzzy classifiers” fit among these three concepts?