



Metal Sequestration during Aggregation Based Crystal Growth

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Introduction:

Siliceous Ferrihydrite (nominally siliceous-Fe(OH)₃) is a ubiquitous nanoparticle (NP) phase in natural environments and commonly contains large concentrations of metals of environmental concern including Pb, Zn, As, Cr, and Ni. Ferrihydrite nanoparticles grow into more robust and crystalline Fe-oxyhydroxides through a process of aggregation-based crystal growth whereby the ~3nm NP physically rotate and bond to produce phases with increasing degrees of crystallinity. These polycrystalline aggregate clusters mature to produce long-range crystallographic alignments with a bladed habit.

Project Overview:

Using previous analyses from UWEC Alumnus Ellyn Swenson and data collected using Transmission Electron Microscopy of 145-150cm-deep soil samples from the Coeur d'Alene Mining District, we created a Crystallinity Index (CI) to measure crystallinity based on observations of electron diffraction imaging and direct lattice imaging of the crystal structure.

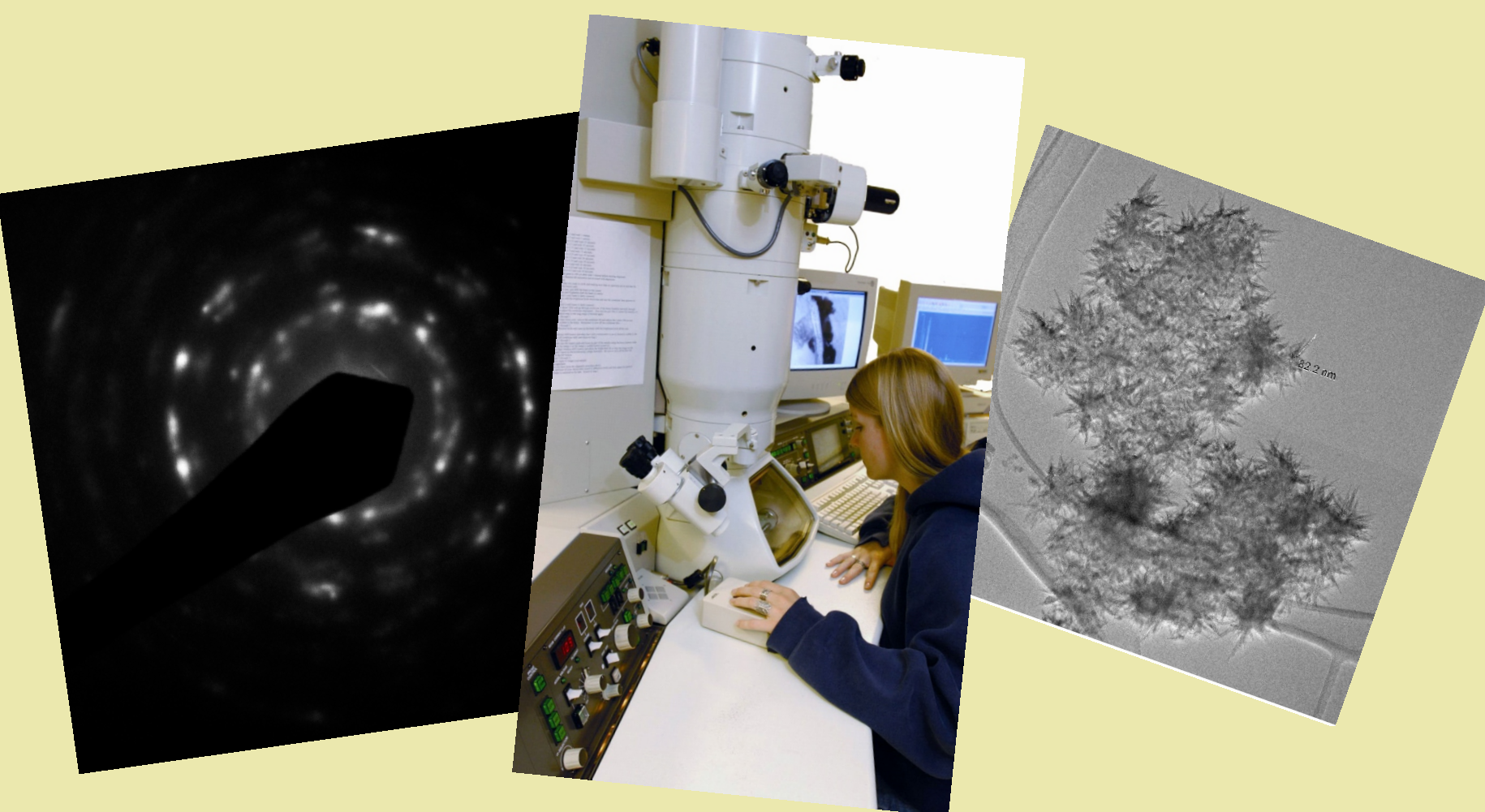
Using this CI based on our interpretation of electron diffraction and direct lattice imaging of crystal structure, we sorted samples into varying categories of crystallinity and compared metal content within each category.

This project is focused on determining how associated metals of environmental concern (especially Pb) behave during aggregation-based crystal growth as a function of increasing CI.

Methods:

Transmission Electron Microscopy-High resolution imaging of nanoparticles diffraction patterns

Energy Dispersive Spectroscopy-Chemical Analyses



Results:

Element of interest concentration as a function of crystallinity shows variable trends depending on the element.

Nanoparticles appear to decrease in Pb content as crystallinity increases.

Ni content appears to increase with crystallinity.

Conclusions:

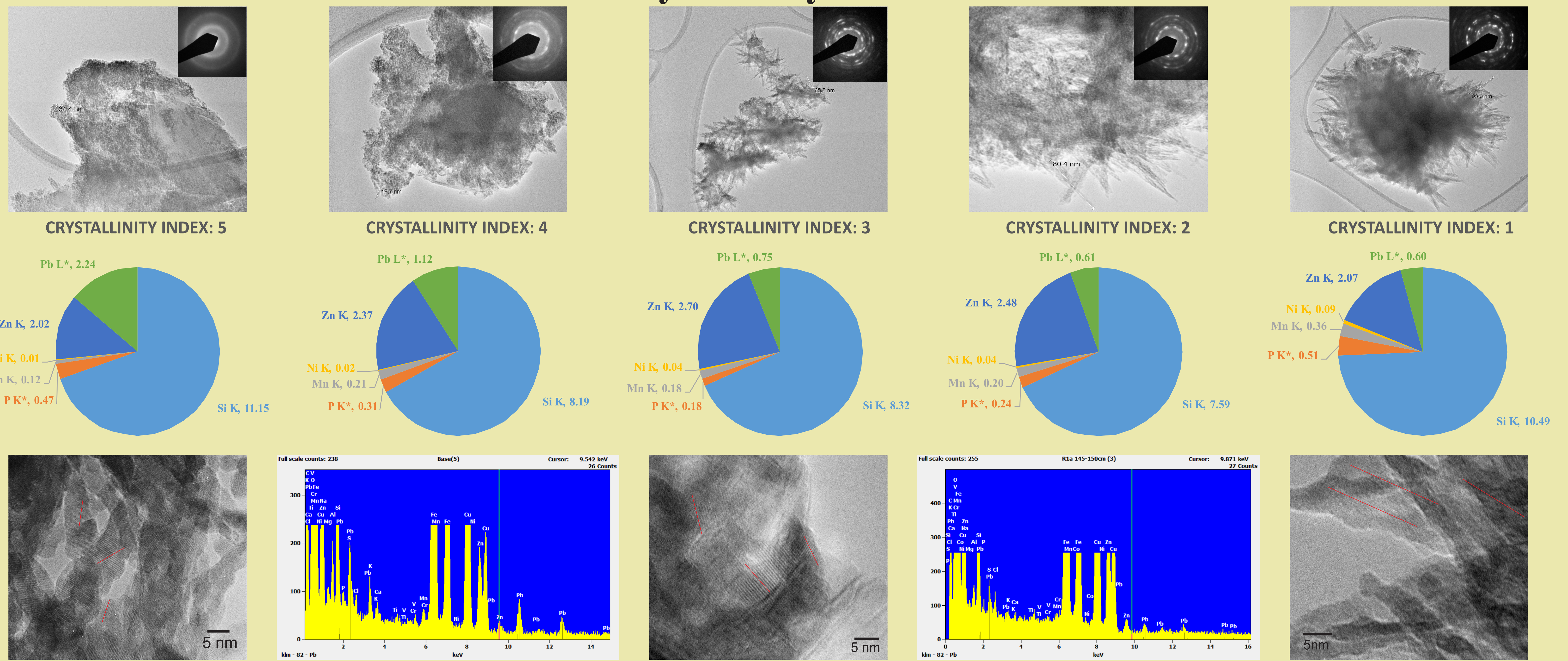
Nanoparticle maturation does not necessarily systematically result in decreasing metal concentrations, although this effect is visible in Pb content.

More data is needed to draw definite conclusions.

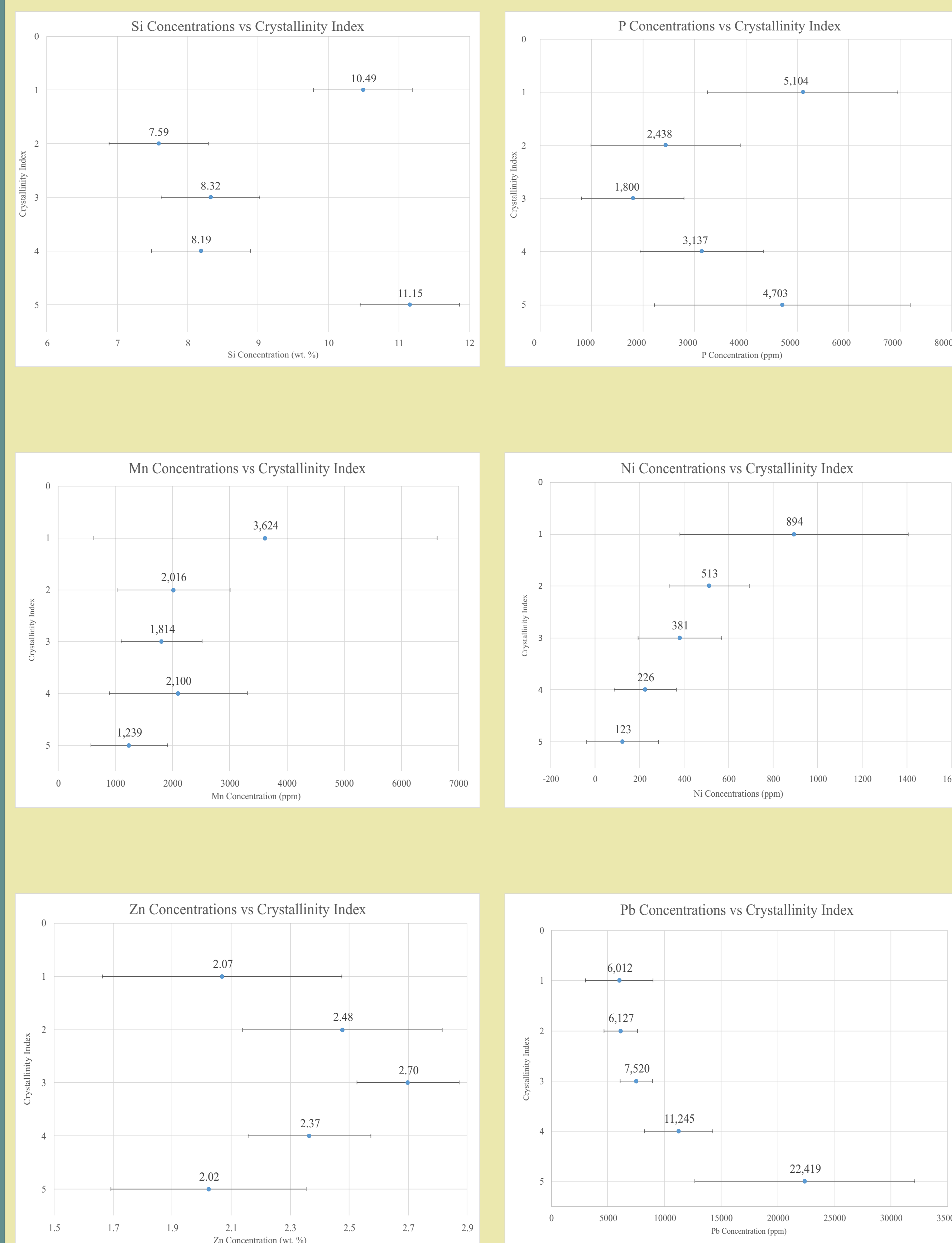
Acknowledgments:

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Crystallinity Index

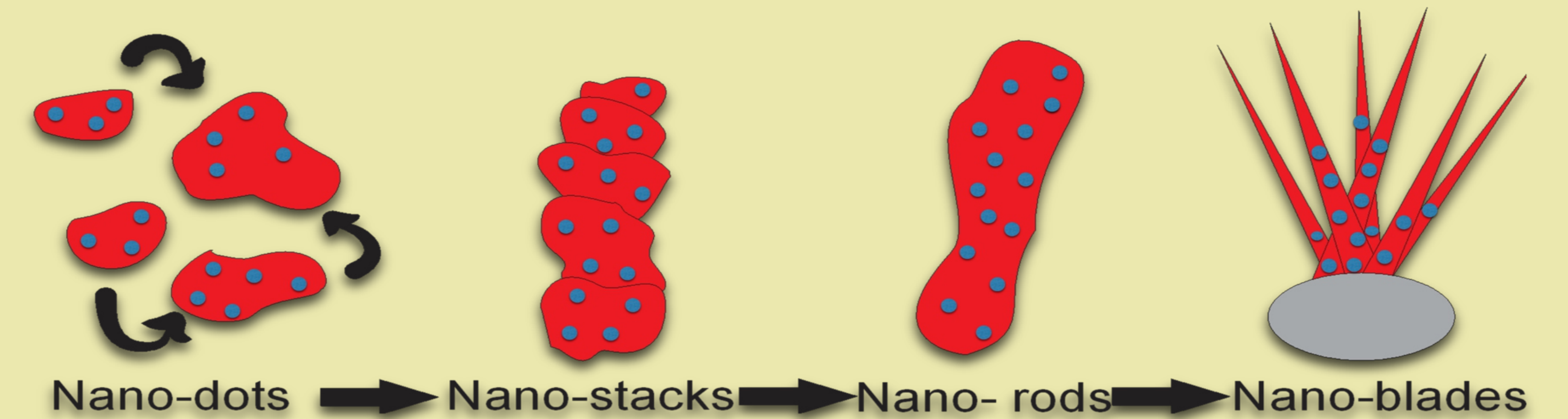
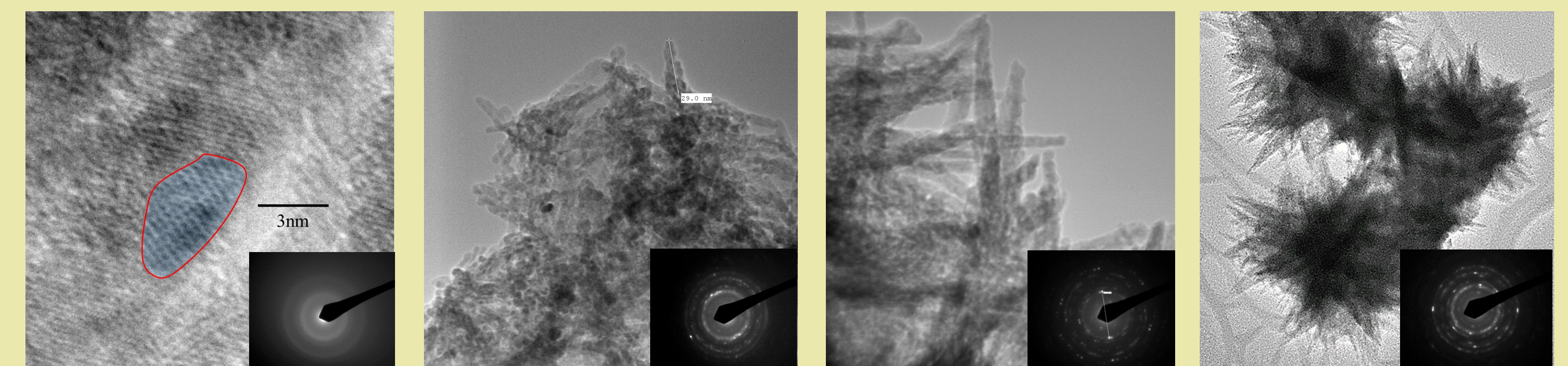
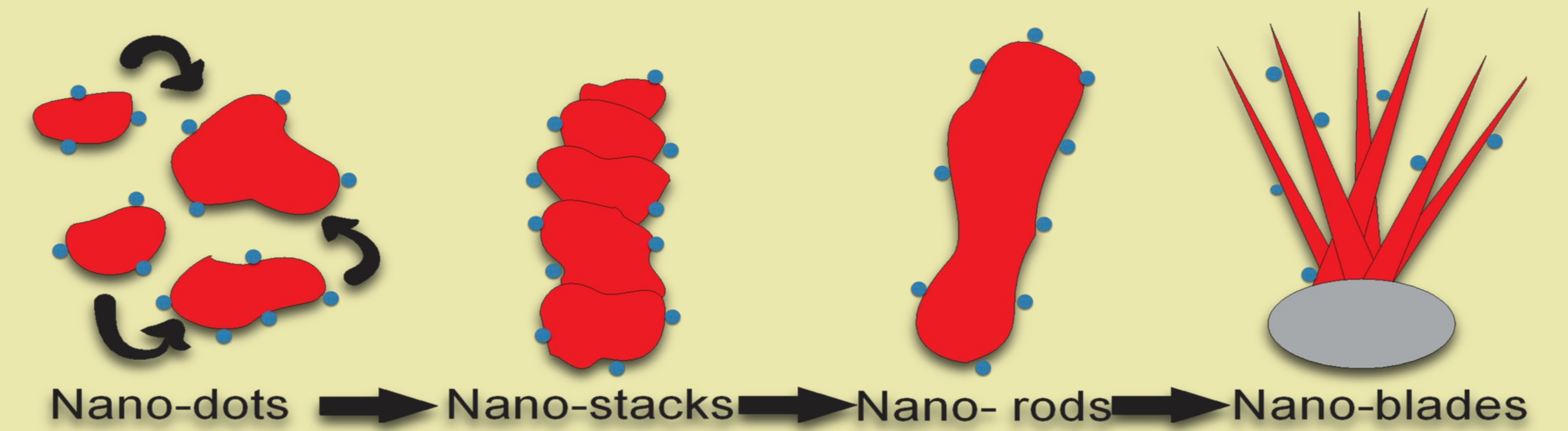


Results



Nanoparticle Growth Models

Adsorption



Co-Precipitation