MAR17-2016-020474

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Self-Assembly of Nanoparticles and Origin of Life

NICHOLAS KOTOV, University of Michigan

Inorganic nanoparticles (NPs) have the ability to self-organize into variety of extended and terminal structures, as do many molecular and nanoscale compounds, given a sufficient number of translational and rotational degrees of freedom. Analysis of experimental data for all NPs (metal, semiconductor, ceramic ..) indicate a general trend of self-assembly under a much wider range of conditions and having much broader structural variability than building blocks from organic matter. Remarkably, the internal organization of self-assembled structures spontaneously produced by NPs rival in complexity and functional sophistication to those found in biology. Multiscale collective effects make NP-NP interactions no less fascinating than those of naturally occurring proteins. In this talk, I will address the following questions:

1. What are the differences and similarities of NP self-organization compared with similar phenomena involving organic and biological building blocks?
2. What are the forces and related theoretical assumptions essential for NP interactions?
3. What is the significance of NP self-assembly for understanding emergence of life?

In this context, self-organization of chiral nanostructures will illustrate the importance of subtle anisotropic effects stemming from collective behavior of NPs and non-additivity of their interactions. Chirality transfer from circularly-polarized photons to NPs and its relationship to the origin of homochirality on Earth, spontaneous compartmentalization (protocells), and out-of-equilibrium chemical synthesis in nanoassemblies.

REFERENCES

1. Kotov, N. A., Science 2010 330 188.
2. Srivastava S.; et al. Science 2010 327 1355.
3. Yeom, J.; et al., Nature Mater. 2015 14 66.
4. Batista C.et al Science 2015 DOI:10.1126/science.1242477.
5. Ming Yang, et al Nature Chem. 2016 DOI:10.1038/NCHEM.2641