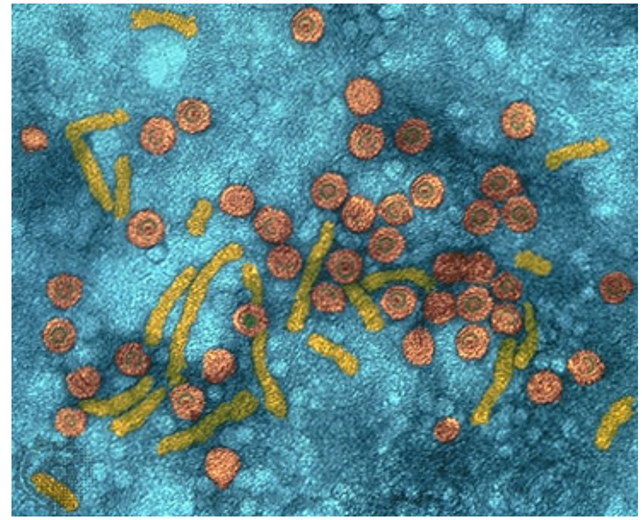


Molecule & Particle Differentiation Using Electrophoresis

Fred Klaessig

Pennsylvania Bio Nano Systems, LLC

fred.klaessig@pabionano.com

Background & Purpose

Specific surface area (SSA):

- AEROSIL® 200 = 200;
- AEROSIL® R974 = 170;
- AEROSIL® R805 = 150; but
- R974 and R805 are surface-treated Ae 200

Explanation: N2 adsorbs on silanols (Si-OH) more than on methyl & octyl groups.

Easy-to-use analytical techniques:

- Interpretations reflect original purpose;
- Underlying principles may not apply across the spectrum of today's samples;

BSA has no SSA, silica does; BSA has a K_{ow}, silica does not.

Braque: Guggenheim

fred.klaessig@pabionano.com

Albumin & Proteins

- Has a specific structure, meaning location of atoms & functional groups
- Has an oil-water partition coefficient;
- Has an isoelectric point (i.e.p. or pI), which is the pH of zero net charge; and
- Represented as particle in separation techniques, but using a thermodynamic partial molar volume.

fred.klaessig@pabionano.com

Exosomes

- Lipid membrane containing a cytosol-like interior (~ 1.2 g/cc);
- Definitely a spherical particle, but not amenable to BET analysis;
- Deformable membrane (wrapping) and trans-membrane proteins migrate in the plane.

fred.klaessig@pabionano.com

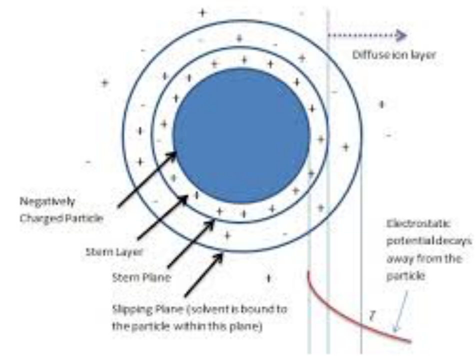
Silica as a Particle

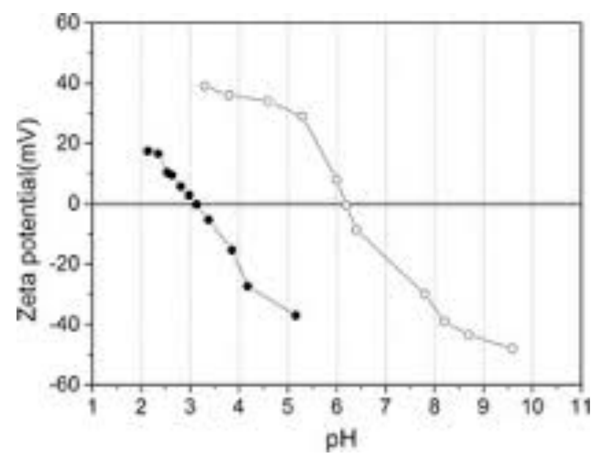
- Definite dimensions, shape, and not deformable;
- Have surface structures, meaning locations for covalently bonded species;
- Migration possible for adsorbed species;
- Surfaces, pores and hollow shapes act as chemical reservoirs
- Has SSA, i.e.p., no K_{ow}

fred.klaessig@pabionano.com

Zeta Potential Titration

- "Titration" more useful than single measurement
- Anatase differentiate from lepidicrocite-layered TiO2
- Acid-base titration curve for species on surface
- Solution titration is for all species





fred.klaessig@pabionano.com

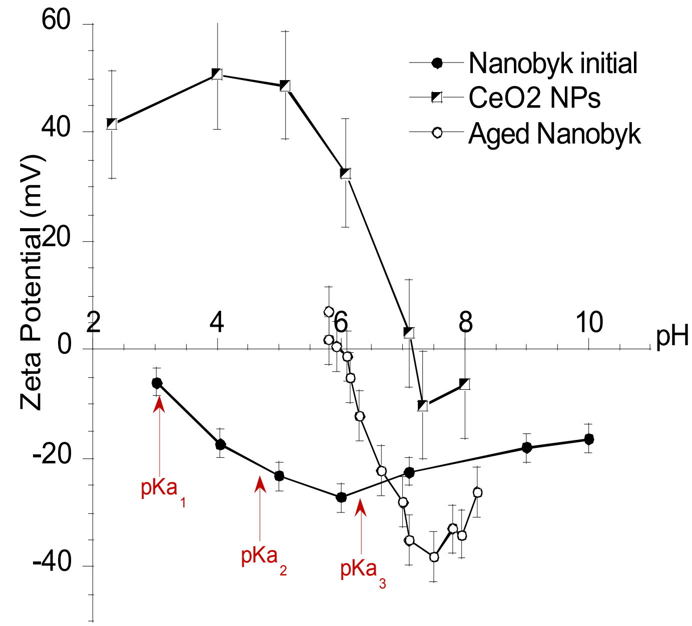
Relevancy to Rhodia

Rhodia CeO2 not in the NM-series and will not "benefit" from NANoREG testing; and

Auffan *et al*. may be responding with a comprehensive study of pristine (Cerox) and citrate-treated (Rhodigard S100) CeO2.

<u>However:</u>

1. Nanobyk (Rhodigard) not representative (low volume, patented, citrate);
2. No controls or reference materials;
3. **Loss of signal interpreted as degradation, but post-adsorption rearrangement is more likely**; and
4. Daphnid testing not using refreshed media (Klaine work that the EPA is favoring)



Unfortunately, placed in Supplementary Information

fred.klaessig@pabionano.com

Adsorbate Conformation

2005 Rhodia authors: 140 PAA chains to disperse, 39 remain and 33% of each remaining chain projects into the medium

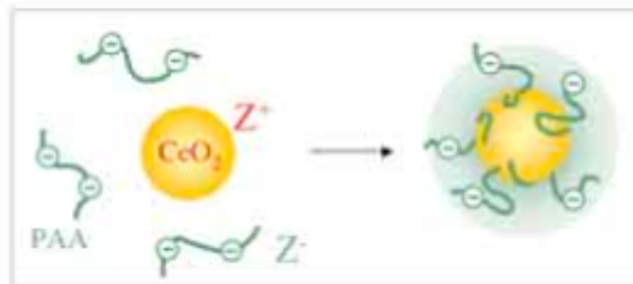


Figure 6 : Schematical representation of PAA_{2K}-coated cerium nanoparticles obtained through the precipitation-redispersion process.

<u>From Grassian Group</u>

2012 thesis: 66% of citrate on CeO2 is bridging and removed in washing; also a function of pH.

2010 TiO2 paper: final citrate IR bands appear with time.

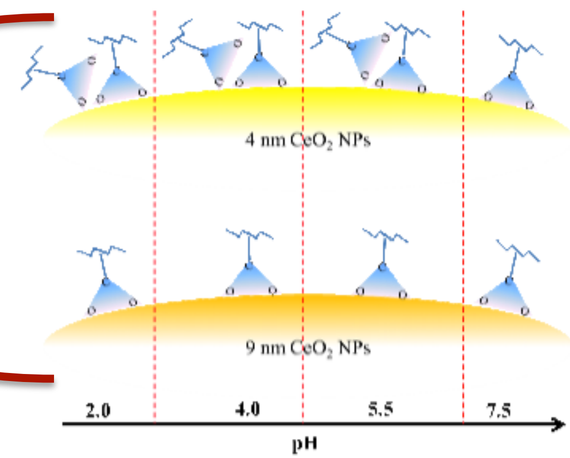


Figure 3.17. Summary of binding modes of citric acid on 4 nm and 9 nm CeO_2 at different pHs: 2.0, 4.0, 5.5 and 7.5

Rhodia precipitates CeO2 in the presence of citrate;
Time= Growth plus post-adsorption rearrangements

fred.klaessig@pabionano.com

Collisions HSA

Diameter (nm)	Exosome g x 10^{-18}	Silica g x 10^{-18}
5	0.07	0.17
10	0.60	1.3
20	5.0	11.1

HAS is 66.5 kDa = 66,500 g/mol, which is 0.11 x 10^{-18} g
HAS is 14 nm by 4 nm by 4 nm (kidney shape)

The particle dominates any collision

fred.klaessig@pabionano.com

Virus Entry as an Example of Membrane Rxn’s

1. Transport, Impingement, “binding”;
2. Lateral diffusion to find receptor or receptor diffusion-in-membrane;
3. Localization of effects at point of membrane “wrapping”;
4. Internalization, trafficking among vesicles and crossing of nuclear membrane; and
5. Reverse process for virions and exosomes

Membrane tensile properties and concentration of receptors, not adsorption, are “rate-limiting”

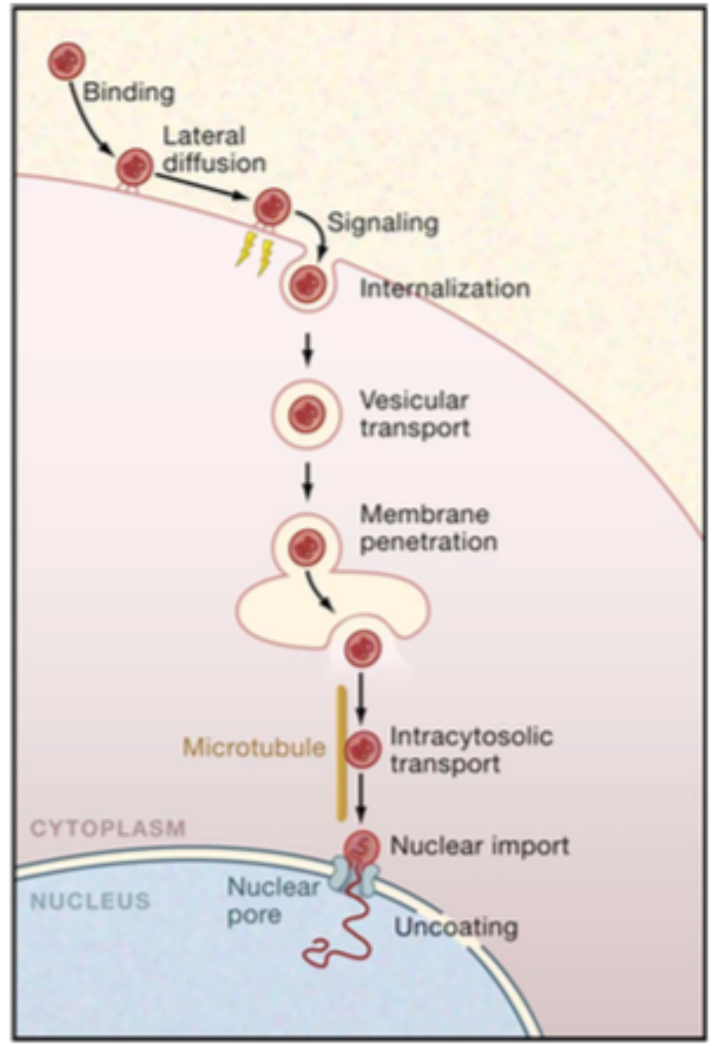


Figure 1. Steps in the Endocytic Entry Program of a Typical Animal Virus

Whether enveloped or nonenveloped, many viruses depend on the

fred.klaessig@pabionano.com

Considerations

- Plain language guide for us:
  - Need analytical input to clarify representations underlying the techniques, e.g. pzc or iep or both?
  - Test technique, i.e.p. values or interpretation preferences likely
  - EPA proposed rule might be basis for the effort
- Ontology:
  - Molecules have structure, particles have NPO, exosomes ???
  - Transport, impingement, binding and lateral diffusion overlap with particles, but collision outcomes differ

Braque: Guggenheim

fred.klaessig@pabionano.com

Kosmulski's Sociological Comments

- atypical terminology was used to describe well-known methods
- Specimens, which have PZC/IEP similar to "recommended" value (e.g., 6 for titania and 9 for aluminas and iron (hydr)oxides), are selected more often than other specimens
- … previously published PZC/IEP act as a self-fulfilling prophecy.
- … contribution of commercial goethites (8 specimens) to the average PZC/IEP of all goethites studied in [1] is negligible.
- … research should be focused on general rules governing the surface charging of certain classes of microorganisms.
- Very likely, the well-established recipes produce clean materials, and the well- established methods produce correct PZCs in most cases, but their consistence must not be considered as a proof that these recipes or methods are superior to their less popular alternatives.

fred.klaessig@pabionano.com

Thank You

Fred Klaessig, Pennsylvania Bio Nano Systems (215) 858-7555

fred.klaessig@pabionano.com

Citations

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fred.klaessig@pabionano.com