

**Nano structured materials-synthesis, properties, self assembly and applications by Prof. A.K. Ganguli, Chemistry Department, IIT Delhi, New Delhi.**

**Module 3 Lecture 10, 11, 12: Core-shell nanostructures**

**Problem :**

1. Define core-shell nanostructures. (nanostructures that contain an inner core covered by a shell)
2. How are core-shell nanostructures different from their single counterpart? (C/s nanostructures exhibit improved physical and chemical properties over their single counterpart)
3. Where do these core-shell nanostructures find application? (medicine, pharmaceuticals and material science: catalysis)
4. What role does miscibility of the material play in formation of core-shell? (the two material should be immiscible)
5. What will happen if the two material exhibit large interfacial energy? (individual particles will be formed)
6. How will lattice mismatch affect the formation of core-shell? (the lattice constant should not differ significantly (usually within 1-3%))
7. Why formations of silica shell important? (porosity can be controlled, optically transparent, silica is a low cost material to tailor surface properties)
8. Name the shell forming agent used for the synthesis of silica shell. (tetraethyl ortho silicate, TEOS)
9. How can one control the shell thickness of silica shell? (by altering the amount of TEOS)
10. What is advantage of silica shell over organic capping agents? (silica shells are stable at high temperature)
11. How is magnetic dipole coupling affected by the formation of silica shell thickness? (magnetic dipole coupling decreases with increase in the shell thickness)
12. Which reagent can be used to form titania shell? (titanium isopropoxide, titanium hydroxyacrylate)

13. How is the surface plasmon band of silver nanoparticles affected by the formation titania shell? (red shift of plasmon band)
14. Expand SERS. (surface enhanced Raman scattering)
15. How is the formation of ZnS shell over CdS improves the optical property of CdS? (ZnS shell supresses the tunnelling of charge carriers from CdS to surface. The shell leads to confinement of photogenerated electrons and holes inside CdS core)
16. Surface area of hollow shell is \_\_\_\_\_ than solid nanostructure. (greater)

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### **Solution :**

1. nanostructures that contain an inner core covered by a shell
2. Core-shell nanostructures exhibit improved physical and chemical properties over their single counterpart
3. medicine, pharmaceuticals and material science: catalysis
4. the two material should be immiscible
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16. greater