Optical Properties of Metallic Nanoparticles

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The ample field of nanoscience comprises all kinds of materials and all kinds of physical, chemical and bioscience properties and effects. There are two common features which characterize this field. First, the size range of nanoscopic samples is, in at least one of the three spatial dimensions, the scale of nanometers. This size scale stands uniquely out by enclosing the transition from small molecule to the state of bulk like materials, which emerges when the sample size is increased. Almost all material properties can, thus, be varied and "tailored" drastically by varying the sample size, which becomes an additional material parameter opening an immensely wide field of novel material properties, unknown in its richness in the world of bulk matter.

And, second, the surface–to-volume relation of such samples is extremely large, the number-ratio of surface to volume atoms even exceeding unity in some cases. Thus nanostructured samples are especially well suited for highly sensitive studies of surface/interface effects.

The extreme complexity and an extensive lack of systematics of nanoeffects prevents, however, a simple and clear description by few analytic laws and rules, as has been so successful in the case of bulk material science.

The first step to a systematic research on fundamental trends of nanosize-effects is, instead, to select and treat most simple model systems. So, one can learn about the principal role of the novel material parameter of "sample size" and about influences of particle surfaces/interfaces.

Hence, this course will be devoted to the most simple and lucid structural model in nanoscience, the spherical particle with all three dimensions on the nanoscale, and to its electronic behavior in the nanosize region. This behavior is most easily and sensitively investigated by measuring and modelling optical properties. The most prominent optical excitation is the "spherical surface plasmon polariton", which is a typical nanosize-effect. Basic properties, evaluated therefrom, are not only relevant for these nanoparticles but can be extrapolated to complex nanostructured systems which are more important for technical applications, e.g. for IT applications.

Main topics :

(1) Introductory Remarks
(2) The Nanosphere as Optical Dipole
(3) The Theory of Mie and beyond
(4) The Optical Material Properties
(5) Nanosize Effects
(6) The Particle Surface / Interface
(7) Electronic Surface / Interface effects
(8) Chemical Interface Reactions
(9) Many-Particle Systems: The Generalized Mie Theory
(10) An Example: The YH_x – Hydrogen Sensor

Time:
from 26 to 30th of october 2009, every morning at 9h00 am.

Place:
Auditorium de l'Institut de Physique et Chimie des Matériaux de Strasbourg, 23 rue du Loess

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