NANO-SURFACES : SURFACES OF NANOPARTICLES

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Surface Science is usually focused on planar, atomically flat surfaces, which are model systems far from common material specimens. A model system of other kind for surface exploration is the surface of (preferredly spherical nanoparticles (*Nanos*), which is more realistic in the variety of more or less imperfect surface structures, depending on special material choices and particle preparation methods.

They cover a broad field from planar facettes with edges, spikes and corners to disordered or non-crystalline boundaries without any Cartesian symmetry, etc
Such surfaces may be transferred into interfaces (or more precisely: three-dimensional “interlayers”) by foreign embedding media, which may be chosen from inert gases to passive or reactive liquids or to metallic, non-metallic or organic solids,

Their thickness may extend from sub-monoatomic layers to bulk-like sur-roundings. Those layers exhibit advantages compared to planar systems, since they may cover the interface completely with high uniformity and without any disturbing substrates.

Nanotechnology now-a-days allow the investigation of single such nanos..

Important advantages of this latter research route are extraordinary application sensitivities of many kinds of experiments., mainly due to the huge surface to inner volume ratio of nanos by which surface properties are scaled up. .

However, draw-backs are still to-day problems with sample preparation and characterization, and not all published experiments overcome them convincingly.

Among the most sensitive experiments are plasmonic surface investigations, which, in addition, give insight into the unique nano-size effects observed in the transition region between solid state nanos and molecular ones.
(General properties of surfaces can, however, only be extracted as long as an individual surface / interface can be clearly defined.)

Recent investigations have shown that in plasmonic excitations all electrons both of the inner particle volume and of the whole surface are involved stemming mainly from the conduction energy band but –to lesser extent- also from deeper lying bands and can be separated from each other with help of extensions of the fundamental work of Mie.

Since Mie’s basic paper, concerning spherical surface plasmon polaritons (SPP’s), it was usual to disregard separate surface material properties and to apply instead dielectric functions averaged over the whole particle. To-day we know that material properties of surface regions of nanos may differ essentially from those of the inner volume. Hence, to bring Mie’s description of the SPP’s into quantitative correspondence with experimental results, we require correction - and extension – effect-models concerning special nano-structure - and nano-surface – effects,. which have to be taken into account in the evaluation of the experimental data. .
Most efficient are various extension - effects to describe the observed strong surface induced relaxation and decoherence effects. One important example, the *Chemical Interface Damping* of the SPP’s , will be treated in this contribution to some detail.

It is the purpose of the present paper to compile several such nano-surface corrections which are useful to obtain more precise informations about nano-surfaces and ,moreover, about realistic surfaces in general.

General Reference:

Uwe Kreibig, Michael Vollmer : *Optical Properties of Metal Clusters /* Springer, Berlin 1995