Nanostructured optical and ferroelectric materials: size-dependent changes of physical and chemical properties

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Optical and ferroelectric materials are widely used in commercial products. Applications include computer memories, sensors, actuators, photorefractive devices, modulators, powder lasers etc. Since there is demand for the miniaturization of electronic and optical components, it is necessary to study size effects at the nanoscale.

It is well known that when dimensions of the crystallites approach the nanoscale their intrinsic properties change significantly. For instance, it has been shown that the ferroelectric properties disappear below a critical crystallite size [1,2]. The change in crystallite size may also lead to significant structural changes or even appearance of new phases not observed for the bulk material [2,3]. Furthermore, novel phenomena may arise from nanometer-size effects [1,4].

I will discuss in this talk the size-dependent effects, which are most important for the application of optical and ferroelectric materials. I will also shortly discuss a few experimental methods, which probe these effects. The main focus will be on the application of spectroscopic techniques such as IR absorption, Raman scattering and luminescence. In the final part of the talk I will present a few examples of recent studies showing size-dependent effects in optical and ferroelectric materials such as perovskites, bismuth-layered compounds, yttria and tungstates.

References

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