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Ionic Liquid Green Synthesis of CeO_2 Nanorods and Nano-Cubes: Investigation of the Shape Dependent on Catalytic Performance

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Abstract

We first introduce a novel nanosize concept and a novel "nanotime" concept along with reviewing a series of novel phenomena and novel techniques related to nanosize effect and ultrafast process, which were recently discovered in our lab or were reported in literature. In these concepts, for the first time we are able to account for the non equilibrium, amorphous-like, and nonlinear nature of the current nanoscience and nanotechnology. In particular, we demonstrate that the structure instabilities of materials occur when a material system is limited to a space within a scale that is comparable to atomic distance. Such a nanosize effect is crucially dependent only on the nanosize but also on nanoshape or nanocurvature (including positive nanocurvature and negative nanocurvature). We also demonstrate that the structure instabilities of materials occur as well when the exchange of external energy with materials is limited to a time within a scale that is comparable to atomic vibration period. Such a "nanotime" effect can give rise to either soft mode or instability of atomic vibration in a condensed matter. The new concepts are very meaningful for control over fabrication and energetic beam processing of low dimensional nanostructures and nanodevices, especially for several potential applications related to nanoparticles, nanocavities, carbon nanotubes，and nanowires.

The new concepts have similarly important implications for chemistry, biology, and medicine as demonstrated by immerging new findings about nanocavities and nanolaser irradiation. In particular, in biology and medicine, there are widespread research interests either in using nanocavity (shell-core) structure to design and build biology composites, biosensors, drug deliverer, and protein structures or in nano surgery via ultrafast nanolaser processing, both being operative at the molecular level dealing with the concepts put forward herein.

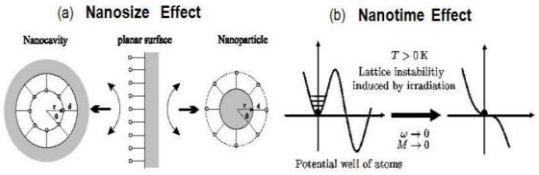

Figure 1 Schematic diagrams showing (a) the concept of nanosize effct: positive curvature of a nanocavity and negative curvature of a nanoparticle and the related surface atomic arrangements; (b) the concept of nanotime effect: irradiation-induced individual atomic vibration instability and soft mode, which, if accumulated to a statistic effect, becomes fundamental source for the athermal activation and the plastic flow (soft modulus)

Biography:

Prof. Xianfang Zhu is one of the earliest scientists who initialized nanoresearch in China in 1985 with over 30 years of research, teaching, and industrial experience in a wide range of materials (metal, ceramic, semiconductor, biomaterials, and polymer) science and engineering areas. He received PhD in Electronic Materials Engineering on nanostructures and their metastability in silicon induced by ion bombardment at the Australian National University in Canberra. Thereafter, he joined University of Illinois at Urbana-Champaign as a postdoctoral researcher, working on the stability of nanostructures in semiconductors under energetic beams irradiation at the Frederick Seitz Materials Research Laboratory to extend his concepts and explore nanoinstability under electron beam irradiation as well as to develop inorganic/organic coreshell nanostructure. He once also worked as associate professor at the Institute of Solid State Physics, Chinese Academy of Sciences; as a visiting scholar at National University of Singapore; as a senior researcher at the ODU Applied Research Centre in the Jefferson Lab; and as an assistant professor at the University of Georgia on fabrication of low dimensional nanostructures for potential nanotechnology and nanodevice applications.

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