New nanoscale parameter resolves dilemmas on silicon property

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The new discovery by Aalto University can have major impact on future nanoscale device design, such as ultraviolet photo detectors and drug delivery.

In bulk size, many materials like silicon are as brittle as glass. In nanoparticle size, the same material can be compressed into half their size without breaking them. The new discovery was made by an international research group led by Professor Roman Nowak.

Atom by atom, the researchers followed the rearrangements resulting from squeezing tiny spheres of silicon. They found that the response of the material varied depending on the degree of deconfinement that contrasts the wellknown "size effect". Shrinking the size of material volumes drives unexpected deformation mechanisms under mechanically induced shape changes.

In its bulk form, silicon is known to display plasticity characterised by phase transformations. However, the research found that progression from a state of relative constraint of the bulk to a less constrained state of the nanoparticle leads to a shift in silicon's mechanical response.

Not a mere peculiarity, the study provides a basis for understanding the onset of incipient plasticity in nanovolumes thus a repeatable vehicle for generating crystal imperfections that dramatically impact functional properties and biocompatibility. The succinct explanation of this topic affects future nano-devices such as ultraviolet photo detectors, lasers on

a chip, drug delivery, and biological markers.

The introduction of the "nanoscale confinement" parameter has never explicitly been taken into account so far for size dependent phenomena. The finding resolves dilemmas noted by the earlier studies and offers avenues to a broad range of nananoscale device design. The results resolve a controversy noted in previous studies and the insight will benefit the processing of future nanostructures in a large scale.

More information: D. Chrobak, N. Tymiak, A. Beaber, O Ugurlu, W.W. Gerberich and R. Nowak, Deconfinement leads to changes in the nanoscale plasticity of silicon, *Nature Nanotechnology* 6 (2011) 480. www.nature.com/nnano/journal/v … /nnano.2011.118.html

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