

# High pressure gold nanocrystal structure revealed

EurekAlert!

A major breakthrough in measuring the structure of nanomaterials under extremely high pressure has been made by researchers at the London Centre for Nanotechnology (LCN).

Described in Nature Communications, the study used new advances in x-ray diffraction to image the changes in morphology of gold nanocrystals under pressures of up to 6.5 gigapascals.

Under high pressures, imaging methods such as electron or atomic force microscopy are not viable, making x-ray diffraction imaging the only option. However, until recently, focusing an image created with this method has proved difficult.

Using a technique developed by LCN researchers to correct the distortions of the x-ray beams, the scientists, working in collaboration with the Carnegie Institution of Washington, have now been able to measure the structure of gold nanocrystals in higher resolution than ever before.

Professor Ian Robinson, who led the LCN's contribution to the study, said: "Solving the distortion problem of the x-ray diffraction images is analogous to prescribing eye glasses to correct vision.

"Now this problem has been solved, we can access the whole field of nanocrystal structures under pressure. The scientific mystery of why nanocrystals under pressure are up to 50% stronger than bulk material may soon be unravelled."

To carry out the research, a 400 nm diameter gold nanocrystal was put into a device called a Diamond-Anvil Cell (DAC) which can recreate the immense pressures which exist deep inside the Earth, creating materials and phases which do not exist under normal conditions.

The sample was crushed within the device and the changes were imaged as the pressure, measured by a small ruby sphere, was increased. The study showed that under low pressure, the nanocrystal acted as expected and the edges became strained, however, surprisingly, the strains disappeared under further compression.

The scientists explain this by suggesting that the pressurised material is undergoing "plastic flow", a phenomenon whereby a material will start to flow and become liquid once it reaches a critical pressure. This hypothesis was further supported when the faceted shape of the crystal developed a smoother and rounder shape as the pressure increased.

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Professor Robinson added "This development has great potential for exploring the formation of minerals within the Earth's crust, which transform from one phase to another under pressure"

In the future, this technique offers a very promising approach for in-situ nanotechnology development under high pressures.

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