Changing gold

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Gold is not as noble and stable as it has been previously thought. This is the conclusion of an international team of researchers from Germany, France and Sweden who came to the ESRF to study the structure of this material at high pressure. They present their results in *Physical Review Letters*.

The uniqueness of gold and its appreciation as a valuable throughout history is closely related to its exceptional stability to chemical reactions and extreme pressures and temperatures. Gold was considered as a synonym of immovability and constancy (remember the wedding rings!). Indeed, at ambient pressure gold has been known to remain stable in a cubic crystalline phase to at least 180 GPa (one million eight hundred thousand atmospheres).

Scientists from the Bayerisches Geoinstitut and the University of Heidelberg (Germany), together with researchers from Sweden and the ESRF (France) have detected for the first time a phase transformation in gold using the synchrotron. The experiments have shown that at pressures above ~240 GPa gold adopts an hexagonal-close packed structure.

In order to carry out their experiments, scientists used two beamlines of the ESRF combined with a new instrument at the Bayerisches Geoinstitut. The sample was placed inside a diamond anvil cell, which was then electrically heated externally. This allowed them to study gold at the pressures of the Earth's core, that is, at a depth of 5500 km from the surface.

Advances in high-pressure techniques require standards which are applicable at a multimegabar pressure range. Large pressure and temperature stability of the cubic gold phase and its high isothermal compressibility make gold an ideal material to be used as a pressure marker at high pressure- high temperature experiments at pressures above 100 GPa. The pressure-induced phase transition found in gold at pressure above 240 GPa places a "natural" limit on the application of cubic gold as a standard.

These results confirm the theoretical predictions about the phase changes in gold. "These new experimental and theoretical results remind us that there is no "absolute" unchangeable material, and the noblest of all metals, gold, is not an exception from this rule", explains Leonid Dubrovinsky, main researcher.

Reference: L. Dubrovinsky, N. Dubrovinskaia, W. A. Crichton, A. S. Mikhaylushkin, S. I. Simak, I. A. Abrikosov, J. S. de Almeida, R. Ahuja, W. Luo, and B. Johansson. Noblest of All Metals Is Structurally Unstable at High Pressure, *Phys. Rev. Lett.* 98, 045503 (2007).

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