Coexistence of superconductivity and magnetism

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(PhysOrg.com) -- Scientists from the University of Sydney are celebrating the 100th anniversary of superconductivity with a discovery of their own.

As part of an international collaboration, researchers from the University's Australian Centre for Microscopy and Microanalysis have identified a link between superconductivity and magnetism. Their results were published today in the international physics journal, *Physical Review Letter.*

Previously, superconductivity and magnetism have been considered to be 'at war' says Dr Wai Kong Yeoh, who led the effort around 'Probing Atoms to Understand the Coexistence of Superconductivity and Magnetism'.

Using a technique known as atom probe tomography, a cutting-edge microscopy technique that provides atom-by-atom map of a material, Dr Yeoh captured a three-dimensional image which shows the structure of Fe-based superconductors. The image shows coexistence of magnetism and superconductivity, in which dopant atoms are observed forming nanoscale clusters. These clusters contain only a handful of atoms.

"Complementary advanced quantum-mechanics based simulations demonstrated that these clusters underpin the unique properties of this material.

Research towards establishing the interplay between these two states, that usually only coexist under very restricted conditions, has the potential to lead to exotic new condensed-matter physics or the development of advanced superconducting based devices, with application in nanoelectronics, quantum computing or high-resolution magnetic measurement" says Dr Yeoh.

The results demonstrate the potential of this approach, combining nanoscale materials characterisation and advanced simulations, to open new pathways to advance superconductor science.

Provided by University of Sydney