ELECTRONIC DOPING OF QUANTUM DOTS

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In investigations published recently in Physical Review Letters and Applied Physics Letters [1,2], two prestigious physics journals, a team led by Rui N. Pereira, researcher at the Department of Physics of the UA and at the I3N, measured for the first time the interactions that take place between dopant atoms confined in quantum dots of semiconductor materials, using electron paramagnetic resonance. Dopants are atoms added to semiconductor materials that by donating electrons enable the tuning of electronic properties.

The researchers used silicon quantum dots doped with phosphorous atoms to demonstrate that the exchange interaction between dopants inside a quantum dot depends enormously on the relative orientation of the dopants and not only on the inter-dopant distance. Thus, depending on the specific dopants configuration, their interaction energy may take values in a range spanning 3 orders of magnitude, even for quantum dots with a diameter of only 4 nm, where the range of possible inter-dopant distances is small.

Quantum dots are tiny crystals with dimensions of only a few nanometers with uncommon size-dependent physical properties. Doping of quantum dots is expected to enable the control of electronic, optic and magnetic properties key for future application of these materials in for example photovoltaic devices, thin-film transistors, and biomedical tagging. Yet the practical exploitation of quantum dots requires that major scientific advances are achieved in terms of controlling and understanding doping phenomena.
The research team member António José Almeida, PhD student of the UA within the MAP-Fis Doctorate Programme, has been distinguished in 2013 by the Calouste Gulbenkian Foundation with a Research Stimulus Prize for his contribution to this research project.

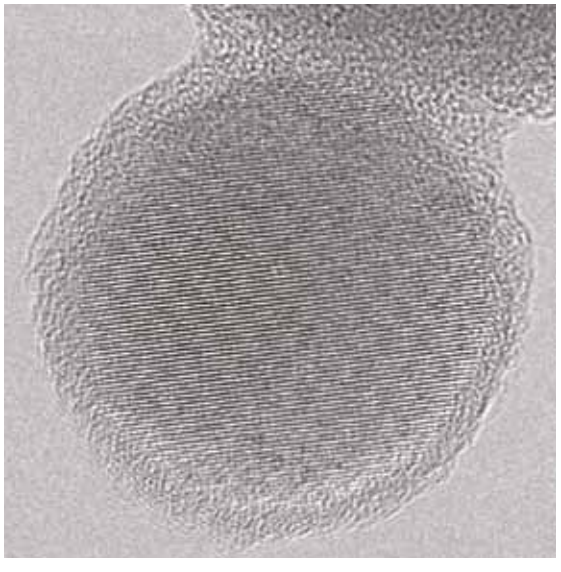

FIGURE 1
Quantum dot.