seminars

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Nanociencia y Nanotecnología: lo pequeño es diferente

Nanoscience and Nanotechnology: small is different

seminar

Friday 27th January

c/Faraday, 9
Conference Hall
Imdea Nanociencia
Ciudad Universitaria de Cantoblanco

12:00h

Exploring the metal-insulator transition in pure and doped V_2O_3 (ultra) thin films

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The metal-insulator transition (MIT) in vanadium oxides is a long-standing topic of experimental and theoretical research in condensed matter physics. In particular, vanadium sesquioxide (V_2O_3), with a very rich phase diagram as a function of temperature and doping, is considered a paradigmatic example of strongly correlated materials that show an MIT.

At ambient conditions, stoichiometric V_2O_3 is a paramagnetic metal (PM) with a rhombohedral structure that is isostructural with corundum Al_2O_3. Upon cooling below 150–160 K, V_2O_3 undergoes a MIT with an increase in resistivity of over 7 orders of magnitude to an antiferromagnetic insulating (AFI) state, accompanied by a monoclinic distortion. Doping with a small percentage of Cr stabilizes a paramagnetic insulating (PI) phase at high temperature that is isostructural with respect to the PM phase. On the other hand, a small percentage of Ti doping or an oxygen excess results in a gradual decrease of the PM-AFI transition temperature down to 0K, stabilizing the PM phase at all temperatures.

In this talk I will present our results on the study of structural and electrical properties of pure and Cr-doped V_2O_3 (ultra)thin films. We observe that the MIT is strongly attenuated in films with thicknesses up to few units cells grown on Al_2O_3. However, when these extremely thin films are grown on a better lattice-matched material such as Cr_2O_3 the MIT is recovered. On the other hand, we have also studied the effects of doping the V_2O_3 films with Cr. Interestingly, we observe a collapse of the insulating state for low doping concentration (between 1% and 4%). This is likely caused by a small excess of oxygen present in the thin films.

Our findings show the importance of the effects of strain and doping on the MIT in V_2O_3. These results are not only interesting from the point of view of the physics of strongly correlated materials but can also be relevant for possible applications of MIT materials in devices.

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