Nanoscience in Austria leads the way

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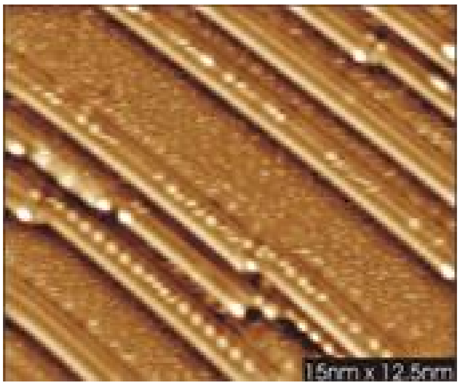

Nickel-rhodium nanowires exhibit surprisingly high reactivity towards oxygen. As a result, they offer future development potential for new types of chemical catalysts. These findings were the result of research by an Austrian and Swedish research group who succeeded in growing one-dimensional nickel stripes on a rhodium substrate in a controlled manner. The team is part of the national research network "Nanoscience on Surfaces", which has been supported by the FWF Austrian Science Fund since December 2003.

Atoms on the surfaces and borderlines of matter behave differently to atoms inside its volume due to their position at the boundary. Significantly altering the surface area to volume ratio can have a major impact on the chemical and physical properties of a material - even if its chemical composition remains unchanged. Research into surface effects is particularly important in nanotechnology because nanoscale structures are - in extreme cases - one-dimensional and therefore almost purely surfaces. Prof. Falko Netzer from the Institute of Physics at Karl-Franzens University in Graz, Austria, is responsible for coordinating work in this field within the national research network "Nanoscience on Surfaces".

THE RESEARCH DIMENSION

Prof. Netzer and his team recently succeeded in establishing a model that can be used to study the reactivity of metallic nanosystems at an atomic level. Prof. Netzer explains: "We succeeded in using physical vapour deposition to form quasi one-dimensional rows of nickel atoms on a special rhodium substrate. This single crystal rhodium substrate has a precise step structure, whereby steps that are only one rhodium atom high are interspersed with terraces that are several atoms wide." The team was able to create a bimetallic system with precisely defined nanoscale dimensions by accurately depositing nickel atoms at the step edges.

Prof. Netzer's group then analysed the chemical reactivity of this system via scanning tunnelling microscopy, complex calculations and x-ray photoelectron spectroscopy using synchrotron radiation at Lund University in Sweden. These analyses produced interesting results which demonstrated that the nickel rows exhibited unusually high reactivity towards oxygen. This enhanced reactivity is caused primarily by shifts in specific electronic states of rhodium atoms in the step structure. This shift then transfers to the directly adjacent nickel atoms and facilitates their reaction with oxygen.

REACTIVE

Prof. Netzer explains the potential of this enhanced reactivity with oxygen: "Our measurements and calculations provide clear evidence that one-dimensional nickel rows can fully react with oxygen at a specific gas pressure - without even one rhodium atom reacting with oxygen. As a result, this system offers opportunities to develop new catalysts, involving the adsorption and dissociation of oxygen atoms."

Prof. Netzer believes that these results underline once more the key role that fundamental research into nanomaterials plays with regard to their future application in day-to-day processes. It was the importance of fundamental research such as this that motivated Prof. Netzer and a number of his Austrian colleagues to establish the research network "Nanoscience on Surfaces" in 2003, and the network has received support from the FWF Austrian Science Fund ever since. The network includes groups specialising in surface technology from the Karl-Franzens University in Graz and the universities of Vienna, Linz, Innsbruck as well as from the Technical Universities of Graz and Vienna. This diverse network facilitates interdisciplinary cooperation comprising a range of methods from physics, chemistry and material science with the aim of creating and characterising defined nanostructures on surfaces. Indeed, scientists and engineers will only be able to use this technology reliably and efficiently when chemical and physical procedures are understood and mastered at the nanoscale level.

Image and text will be available online from Monday, 18th June 2007, 09.00 a.m. CET onwards:
www.fwf.ac.at/en/public_relations/press/pv200706-en.html

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The Austrian Science Fund (FWF) is Austria's central body for the promotion of basic research. It is equally committed to all branches of science and in all its activities is guided solely by the standards of the international scientific community.

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