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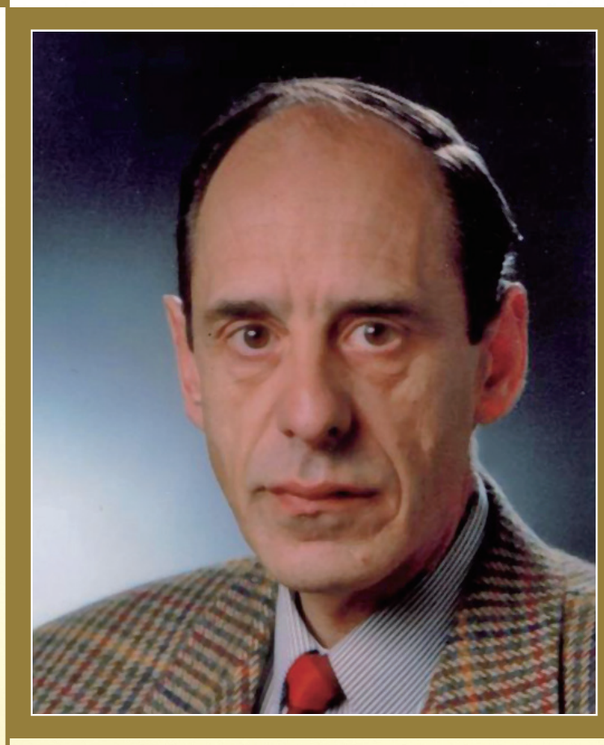

Speaker

Professor Herbert Gleiter

Senior Member and Institute Professor of the Institute of Nanotechnology
Karlsruhe Institute of Technology

Nanostructured Solids—From Nanoglasses to Quantum Transistors: The Door to a New Generation of Technologies?

on
Wednesday, 14 May 2014 at 4:30 pm
at
Connie Fan Multi-media Conference Room
4/F Cheng Yick-chi Building
City University of Hong Kong
Tat Chee Avenue, Kowloon

Abstract

Modern technology is based on the fact that the properties of crystalline solids can be controlled by modifying their atomic structure (e.g. by structural phase transformations or by introducing lattice defects) and/or by varying their chemical composition (e.g. by alloying/doping). Comparable structural/chemical modifications of today's glasses are not possible because their atomic structures and their chemical compositions are given by the structures/compositions of the corresponding rapidly cooled melts at the glass transition temperature.

It is the novel feature of nanoglasses that they open the way to generate solids with a non-crystalline atomic structures and with chemical compositions that differ from the atomic structures and the chemical composition of the glasses available today. In fact, it seems that to every crystalline material available today, the analog non-crystalline material (with new properties due to the non-crystalline structure) may be synthesized by means of nanoglasses. Due to their novel atomic as well as novel chemical structures, the properties of nanoglasses can be controlled by modifying their atomic structures (e.g. by introducing structural defects) and/or by varying their chemical compositions (e.g. by alloying in the form of single or multi-component nanoglasses).

A group of structures that is closely related to nanoglasses are structures that consist of nanometer-sized crystals embedded in an aqueous electrolyte. By varying the boundary conditions for the formation of these nanometer-sized crystals, the size, the shape and the electronic structure of these crystals can be switched reversibly in a controlled manner so that switchable quantum transistors are obtained.

In summary, nanoglasses were found to exhibit a variety of new and technically attractive biological, magnetic, mechanical, electric etc. properties. History indicates that the discovery of materials with new properties (e.g. the discovery of bronze, iron, semi-conducting materials etc.) was the beginning of the development of an age of new technologies. Hence, the discovery and the new properties of nanoglasses may also open the way to a period of mankind characterized by an age of new technologies utilizing the novel properties of nanoglasses i.e. a kind of "glass age".

However, at present, the large scale technological application of nanoglasses is still hampered by the unavailability of economic methods for producing large quantities of these materials.

Biography

Professor Herbert Gleiter obtained his Ph.D. in Physics from the Max Planck Institute of Materials Science and the University of Stuttgart. In 1982, he founded the Institute of New Materials at the University of Saarbruecken, which is today Germany's second largest institute working in the area of new materials. In 1994, he joined as President of Research and Technology, the Executive Board of the Research Center Karlsruhe, which is Germany's largest national laboratory. He initiated the international Neutrino Mass Experiment "Katrin", the new KIT X-ray light source (ANKA) and the Institute of Nanotechnology (INT) at KIT, Karlsruhe. The INT is today Germany's largest research institute in the area of nano-science and nanotechnology with more than 15 interdisciplinary research groups from the Universities of Karlsruhe, Strassbourg, Darmstadt and Basel. The research activities of these groups extend from cluster physics, nano-materials all the way to photonic materials, supra-molecular chemistry/physics, both in experiment and theory.

Professor Gleiter's contributions have been cited more than 18,000 times and have achieved the highest citation impact score in Materials Science in Germany and are number two in Europe. Throughout his career, he has received more than 40 prizes and awards, including the Leibniz Prize, the Max Planck Research Prize, the Gold Medals of Acta Materialia and of the Federation of European Materials Societies, the 2008 Staudinger-Durrer Lecture Award of the Swiss Federal Institute of Technology, and in 2009 the Blaise Pascal Medal of the European Academy of Sciences. He has been awarded honorary doctorates from three German/Suisse universities, and several honorary professorships/doctorates from foreign universities. Nanjing University of Science and Technology founded a new research institute working on nano-science named after him and appointed him Founding Director of the "Herbert Gleiter Institute of Nanoscience".

He has been elected a Fellow/Honorary Member of numerous professional Societies such as the Japanese Society for Promotion of Science, the Materials Research Society of United States, of India, of the American Nano Society, the Indian Society of Mathematical Modelling as well as of the German Materials Society.

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