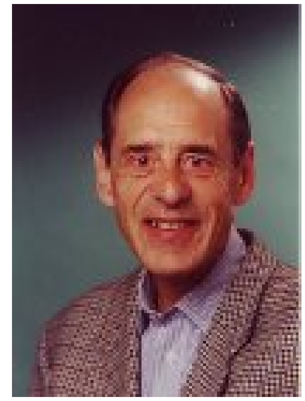
Institute Lecture

Can Nanoglasses open the Way toan Age of New Technologies?



Herbert Gleiter

Honorary Adviser, Founder and former Director,Herbert Gleiter Institute of Nanoscience, KIT Distinguished Senior Fellow

Tuesday, 27thJanuary 2015, Time: 5-6 PM, Venue: Outreach Auditorium

Abstract

Nanoglasses are a new class of noncrystalline solids. They differ from normal glasses due to their microstructure that resembles the microstructure of polycrystals. In fact, they consist of regions with a melt-quenched glassy structure connected by interfacial regions, the structures of which is characterized (in comparison to the corresponding melt-quenched glass) by (1) a reduced density, (2) a reduced number of nearest-neighbor atoms resulting in an electronic structure that differs from that of the corresponding melt-quenched glass. Due to their new atomic and electronic structures, the properties of nanoglasses may be modified by controlling the size of the glassy regions. Similar to multiphase polycrystals, multiphase nanoglasses are obtained by assembling nanometer-sized glassy regions with different chemical compositions opening the way to non-crystalline solid solutions of components (e.g. ionic and metallic components) that are immiscible in the crystalline state. Due to their new atomic, electronic and chemical structure, nanoglasses exhibit new properties, e.g., $Fe_{90}Sc_{10}$nanoglass is (at 300 K) a strong ferromagnet whereas the corresponding melt-quenched glass is paramagnetic. Moreover, nanoglasses were noted to be more ductile, more biocompatible, catalytically active and form solid solutions of components that are immiscible in the crystalline state. Hence, nanoglasses may open the way to a world of technologies based on non-crystalline materials different from today's technologies based predominantly on crystalline materials (e.g. metals, semiconductors, and ceramics)

About the speaker

Herbert Gleiter obtained his PhD in 1966 in Physics from the University of Stuttgart. After spending several years at Harvard University and MIT, he accepted positions at the Universities of Bochum, Saarbruecken and the ETH Zurich. In 1994, he joined the Executive Board of the Research Center Karlsruhe and founded Institute of Nanotechnology.

During his work at Harvard and MIT he discovered the existence of dislocations in inter-crystalline interfaces and proposed the "structural unit model" of grain boundaries which provides the basis for today's grain boundary models. In the late 1970s, he pioneered a new class of materials: nano-crystalline materials. The idea of these new materials was to create solids consisting of a large (50% or more) volume fraction of inter-crystalline boundaries between crystallites with the same or with different chemical compositions (single phase or multi-phase nano-crystalline materials). As the arrangements of atoms in interfaces differ from the ones in crystals and glasses, nano- materials were expected to open the way to solids with new atomic structures and hence new properties. This idea was confirmed by the rapidly growing number of subsequent studies on nano-materials world-wide. In 1989 he initiated the development of new class of noncrystalline solids, the so called nano-glasses. His present work focuses on the application of nanotechnology to probe limits of Quantum Physics in systems of macroscopic size.

Throughout his career he received more than 40 prizes/awards including the Leibniz and Max Planck Prize as well as four honorary doctorates, several honorary professorships and was recently appointed Founding Director of the "Herbert Gleiter Institute of Nanoscience" at Nanjing, China. He is a member of seven National Academies as well as an Honorary Member of several professional societies.

Tea at 4:45PM; All interested are welcome.

K. Muralidhar
Dean of Research and Development