NON-CRYSTALLINE NANOSTRUCTURED MATERIALS: THE WAY TO NEW SOLIDS WITH NEW STRUCTURES AND PROPERTIES

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Today's technologies are based primarily on utilizing crystalline materials (e.g. metals, semiconductors or crystalline ceramics). The way to new technologies may be opened by nanostructured materials that are totally or partially on non-crystalline. One group of them are nano-glasses. They consist of nanometer-sized glassy regions connected by (nanometer-wide) interfacial regions with atomic and electronic structures that do not exist in melt-cooled glasses. Due to their new atomic/electronic structures, the properties of nano-glass differ from the corresponding properties of melt-cooled glasses. For example, their ductility, their biocompatibility, their catalytic and ferromagnetic properties are changed by up to several orders of magnitude. Moreover, they permit the alloying of components e.g. ionic materials (e.g. SiO) and metallic materials (e.g. PdSi glasses) that are immiscible in the crystalline state. The properties of nano-glasses may be controlled by varying the sizes and/or chemical compositions of the glassy clusters which opens the perspective of a new age of technologies - a "glass age". A second group of nanostructured partially non-crystalline materials with tunable properties are nano-porous metals with electrolyte filled prores. By applying an external voltage between the electrolyte and the nano-porous metal their properties e.g. their superconductivity, magnetic moment, electric resistivity may be varied. Single or multi-atom switchable contacts represent a third group of these materials. They open the way to spontaneously formed single-atom or multi-atom transistors which allow quasi solid state bi-stable switching between quantized conduction levels of $2e^2/h$ or multiples of $2e^2/h$.