Samsonov Memorial International Lecture Series on Inorganic Materials

Third Annual Lecture
Department of Materials Science and Engineering
Indian Institute of Technology Kanpur

Nanostructured Materials in Extremes

Dr. Rostislav A. Andrievski
Institute of Problems of Chemical Physics, Russian Academy of Sciences, Moscow

Day: 11 February, 2014; Place: Lecture Hall -16; Time: 3:30 PM

Professor G.V. Samsonov (1918-1975)

Professor Grigori Valentinovich Samsonov was born on 15th February 1918 in a town near Leningrad (now St. Petersburg). After earning his first degree at the Nonferrous Metals Institute in Moscow, he joined Soviet Navy. At the end of the Second World War, he was stationed in the Soviet occupied zone of Austria. It was here he became intimately connected with the extensive refractory metal and their compounds. After the cessation of the war, Samsonov returned to Moscow and resumed his higher studies and research under the guidance of Professor M. A. Merson (Institute of Steel and Alloys), a noted powder metallurgist of the then USSR. After completion of his Ph.D. degree, Samsonov joined the Institute of Metalkeramika (powder metallurgy) in the Ukrainian Academy of Science at Kiev as a senior scientist. The Institute was later renamed ‘Institute of Materials Problem.’ Within few years, he was elevated to the post of Deputy Director. Simultaneously, he was invited to head the Powder Metallurgy Department of Kiev Institute of Technology.

Samsonov’s scientific activity began with the synthesis of inorganic compounds. Soon he extended his area in the study of structure-properties-processing-performance relations of inorganic materials. By structure he included all types: electronic, atomic, micro- and macro, although the electronic structure fascinated him the most. To achieve this goal he insisted on the crucial bond between chemistry and physics. Samsonov authored nearly 1500 papers and authored/edited 50 books and monographs. One of the seminal books authored by Samsonov is ‘Configurational Model of Matter.’ Probably, there is no paper on refractory compounds, where he is not referred. The inorganic compounds in which Professor Samsonov contributed were carbides, nitrides, borides, silicides, germanides, selenides, phosphides, etc. He has also investigated in detail the hard cermets based on refractory compounds. His numerable past students are spread throughout the world.

About the Speaker

Professor Dr. Rostislav A. Andrievski is currently the Principal Scientist at the Institute of Problems of Chemical Physics, Russian Academy of Sciences, Moscow. He obtained his PhD degree from the Institute of Metal-Ceramics & Alloys at Ukraine Academy of Sciences. His research interests are nanostructured materials, super-hard films, high melting-point compounds, consolidation of nanomaterials, and stability of nanomaterials. He has supervised 33 PhDs, and published 430 scientific publications including 11 books. He is member of four international editorial boards. Corresponding Membership of the Kirghiz Academy of Sciences, and Full membership of the International Institute for the Science of Sintering, are among the major honours he has received.

About the Donor

Dr. Gopal Shankar Upadhyaya joined the department of Metallurgical Engineering (now Materials Science and Engineering) at the Indian Institute of Technology Kanpur as Professor in the year 1976. Prior to that he was Associate professor at the University of Roorkee (now IIT Roorkee) from 1964-1975. He was awarded doctorate degree from the Kiev Institute of Technology, Ukraine in 1969 under the guidance of internationally renowned Materials Scientist Professor G.V. Samsonov. Professor Upadhyaya’s publications list exceeds 300 papers and 16 authored/edited books. He has served on the Advisory Boards of practically all the major conferences and journals in powder metallurgy. Professor Upadhyaya’s past graduate and doctorate students are actively engaged in powder metallurgy research and industry. After retiring from IIT Kanpur (in 2001), Professor Upadhyaya currently resides in Varanasi.
Abstract

The scientific interests of well known scientist Prof. G.V. Samsonov applied to not only aspects of synthesis and properties of materials but covered their behavior in extreme conditions such as at radiation, deformation and corrosion. In continuation of these important traditions, my lecture offers a review of the recent advances in theoretical/experimental data on the nanostructured materials (NMs) behavior at high temperatures as well as in radiation, corrosion and deformation environments.

Modern technique progressively increases demands in working conditions and so new development of structural/functional NMs must be familiarized by extreme environments taking in mind the high level of temperatures in radiation, corrosion, and deformation conditions. The high level of physical/mechanical properties of NMs is due to a nanometric grain size and correspondingly a large share of interfaces, triple junctions, and quadruple points as well as an availability of segregations, nonequilibrium phases, residual stresses, nanopores, and other defects. Thus, almost all NMs are far from equilibrium state. It follows from general considerations that the thermal activation and other effects such as radiation, corrosion, deformation, and others, can stimulate and enhance the diffusion, relaxation, recrystallization, and homogenization processes with partial or total annihilation of nanostructure and degeneration of high level properties. In this connection, the NM stability is one of the important problems in the new NM development for extreme conditions.

Information about thermal, radiation, and corrosion stability of NMs is discussed in details. The great attention is taken to the nanograins size effect and attendant factors such as grainboundary structure, abnormal grain growth, segregations, residual stresses, and others. Many NMs such as based on metals, alloys, compounds, semiconductors, dielectrics, carbon, and composites are considered. Some little-explored and unexplored problems are pointed.

References