



Samsonov Memorial International Lecture Series on Inorganic Materials

Eighth Annual Lecture

Department of Materials Science and Engineering
Indian Institute of Technology Kanpur

Diamond-Metal/Alloy Sintered Composites and Their Properties

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Date: 26 February 2019 Place: L-17 Time: 3:00 PM

Abstract

Historically, the methods of making diamond tools have undergone a remarkable development since the invention of synthetic diamond in the mid-1950s. Until the early 1990s the diamond tool industry had been mainly impeded by the very high cost of diamond, whereas the price of other raw materials, e.g. cobalt-based matrix powders, used in most professional and non-professional applications, had remained at an acceptable level. Merely a few years later, rapid improvements in the cubic type multi-anvil high pressure apparatus took place in China. Large-scale implementation of this modified equipment for diamond synthesis resulted in tremendous price cuts on the diamond supply side and, consequently, markedly increased the contribution of cobalt to the overall tool fabrication costs. To meet that challenge, intensified efforts have been focussed towards substituting fine cobalt powders with iron-base and copper-base alloys. This has resulted in the development a range of diamond composites designed to cater for a wide diversity of tool manufacturing techniques and application conditions. This lecture will focus on the challenges and opportunities in the processing of diamond-based composites through improvements in diamond synthesis techniques and matrix formulations. Some of the binder developments at AGH-University of Science & Technology that include low-alloy iron powders, self-brazing powders for free-sintering of diamond beads, iron-nickel and iron-manganese powders for substitution of Co-WC matrices in abrasive applications will be also discussed.

About the speaker



Dr. Janusz S. Konstanty is Professor at AGH-University of Science & Technology, Krakow, Poland. He received his PhD and DSc from AGH-UST in 1987 and 2002, respectively. He is currently heads the Department of Physical Metallurgy & Powder Metallurgy. He has also served as a Chief Technologist at Kamex Ltd., Zabierzow, where he developed the technology of producing diamond tools for stone processing and construction applications. He has been involved in the research on diamond-based tools and contact materials for nearly four decades. Dr. Konstanty is author of two books, several book chapters and over 100 publications on topics related to diamond tools.

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 donor



Prof. 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.

Previous Speakers

2012: Professor E.J. Mittemeijer (Max Planck Institute for Materials Science, University of Stuttgart, Stuttgart, Germany)

2013: Professor G.S. Upadhyaya (Formerly, Professor IIT Kanpur)

2014: Professor R.A. Andrievski (Institute of Problems of Chemical Physics, Russian Academy of Sciences)

2015: Professor K.A. Padmanabhan (Formerly Director IIT Kanpur)

2016: Professor H. Danninger (Technische Universitat Wien, Vienna, Austria)

2017: Professor P. K. Rohatgi (University of Wisconsin-Milwaukee, USA)

2018: Dr. S. V. Kamat, (Defence Research Development Organization, India)