Innovative Superhard Materials and Sustainable Coatings for Advanced Manufacturing

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PREFACE

Modern industry imposes ever increasing requirements upon tools and tool materials as to the provision for performance under the conditions of high cutting speeds and dynamic loads as well as under intensive thermal and chemical interactions with workpiece materials. The industry demands a higher productivity in combination with the accuracy of geometry and dimensions of workpieces and quality of working surfaces of the machined pieces. These requirements are best met by the tool superhard materials (diamond and diamond-like cubic boron nitride). Ceramics based on silicon carbide, aluminum and boron oxides as well as on titanium, silicon and aluminum nitrides offer promise as tool materials. Tungsten-containing cemented carbides are still considered as suitable tool materials. High-hardness and high strength composites based on the above materials fit all the requirements imposed by machining jobs when manufacturing elements of machinery, in particular those operating under the extreme conditions of high temperatures and loads. These elements are produced of difficult-to-machine high-alloy steels, nickel refractory alloys, high-tech ceramics, materials with metallic and non-metallic coatings having improved wear resistance, as well as of special polymeric and glass-ceramic materials.

Materials science at high pressure deals with the use of high-pressure techniques for the development and production of unique materials whose preparation at ambient pressure is impossible (e.g., diamond, cubic boron nitride, etc.) or of materials with properties exceeding those of materials produced at ambient pressure (e.g., high-temperature superconductors). These materials have found a wide application in various industries, including radio electronics, machine building, transport, aircraft, etc.

Lectures presented at the NATO Advanced Research Workshop “Innovative Superhard Materials and Sustainable Coatings” held in Kiev from 12 to 15 May 2004, comprehensively analyzed the state of the art in materials science of superhard materials, the use of superhard material tools to machine a wide spectrum of workpiece materials and to assess the quality and reliability of the products. This book contains 40 papers of those presented at the NATO ARW in Kiev.

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