ACTUAL PROBLEMS OF METALLURGY

[a]Zufarova N., [a,b]Turakhodjaev N.D., [c]Yuvasheva D.
[a]Tashkent State Technical University, Uzbekistan
[b]Uzbek-Japan Innovation Center of Youth, Uzbekistan
[c]Dalian University of Technology, China

The creators of technology have always strived to ensure that new products are superior to known ones in efficiency and quality. The development of many areas of modern technology is associated with the use of high-strength materials. Science is faced with the problem of making high-strength materials are as reliable and inexpensive as ordinary metals.

The production and consumption of super hard materials, which include many hard alloys, carbides, borides, industrial diamonds, etc., largely characterize the industrial potential and technical power of the country.

These materials are so hard and brittle that they cannot be processed by traditional methods. Technological difficulties were overcome by using the phenomenon of superplasticity when workpieces made of hard materials can be given the desired shape by deformation under pressure. In some materials, heat exposure reveals a "memory effect". Restoration of the original shape of a plastically deformed sample as a result of heating. The mechanism of this phenomenon is due to the structural transformations of the material. The main group of materials is titanium-based alloys.

Currently, they are used in spacecraft antennas that open under the influence of solar heat. The transition of aviation to jet engines gave urgency to the problem of creating materials that can withstand mechanical loads at high temperatures. The reserves of high-temperature strength of alloys based on iron, nickel, aluminum, and other metals are limited and actually exhausted.

This is because the operating temperature of many engine parts reached 1200°C and approached the melting temperatures of alloys.

Thus, the upper limit of operating temperatures of ordinary steels is not exceeds 770°C, nickel and cobalt alloys - 1100°C, etc. Until recently, low values of high-temperature strength of steels were a barrier to the further development of engine building, since the performance characteristics of engines directly depend on the temperature of gases in the turbine.

At present, this problem has been solved by processing metals into granules by high-speed crystallization and then pressing the granules into products. High-speed crystallization occurs as a result of rapid cooling of the melt, resulting in the formation of extremely small microcrystals or even amorphous materials.

At high temperatures, the strength of fine-crystalline and amorphous alloys is 1.5 times higher than alloys obtained using traditional technology.

Cryogenic technology, which ensures the production and use of temperatures below 150°C, solves many production problems related to the liquefaction of gases and the separation of gas mixtures, primarily air. Its achievements led to the development of semiconductors that are used in the energy sector. The requirements for the purity of materials have increased dramatically. Until recently, pure materials met the definitions of technically pure (99.9% main component content) or chemically pure (99.99%). Even higher requirements for the purity of materials in semiconductor technology: the norm of impurities in most materials is less than 10-11%. Consumers of ultra-pure materials are quantum electronics (working elements of lasers), space technology (solar panels, fuel, etc.). Many ultra-pure materials have been found to have unexpected properties. For example, iron and zinc, which are easily susceptible to corrosion, successfully resist it in purified form; considered chromium, titanium, tungsten, molybdenum and other refractory metals become pliable after deep cleaning and can be rolled into foil.

An urgent problem was the protection of materials from chemical interaction with the environment, the aggressiveness of which has increased significantly due to the intensification of human production activity. The costs of eliminating the consequences of wear and tear of materials in machines have reached colossal proportions.

Knowledge of patterns of aging of materials, i.e. changes in their structure and properties occurring over time, is necessary to take measures to stabilize the properties of materials and predict the performance of technical objects. Functional materials, as a rule, include:

– amorphous materials, for the production of which it is necessary to cool metals at a rate of more than a million degrees per second, after which they acquire the structure of glass and an amazing combination of physic mechanical and chemical properties;

– "intelligent" or "smart" materials, characterized by the ability to "remember", track, and return the deformation and shape of the structure;

– intermetallic materials;

– metal, polymer, or carbon matrix composites;

– ultrafine and nanophase materials, the elementary size of the fragments of the structure which is less than hundredths and thousandths of a micron;

– diamond-like superhard films;

– functional-gradient coatings, etc.

The peculiarity of new materials, in contrast to traditional ones, is their closer relationship with the technology of processing into a product. In some cases, the process of manufacturing materials and products from it forms a single whole.

Thus, even such a brief description of modern achievements and problems of materials science and technology of materials production indicates that these scientific disciplines are in the stage of revolutionary changes and are among the key factors of scientific and technological progress.

References

1. Vladimir A. Bataev – Doctor of Technical Sciences, Professor, Deputy Head of the Department, Professor of the Department of Materials Science in Mechanical Engineering.
2. Burov Vladimir G. – Doctor of Technical Sciences, Professor, Professor of the Department of Materials Science in Mechanical Engineering.
3. Ivan A. Bataev – Candidate of Technical Sciences, Associate Professor, Associate Professor of the Department of Materials Science in Mechanical Engineering.
4. Sergey V. Veselov – Candidate of Technical Sciences, Associate Professor, Associate Professor of the Department of Materials Science in Mechanical Engineering.
5. Ekaterina Drobyaz – Candidate of Technical Sciences, Associate Professor, Associate Professor of the Department of Materials Science in Mechanical Engineering.