

Progress in various fields of engineering is directly related to the development of materials technology. The increasing demands of the industry force further development and use of materials with increasingly better functional properties, and thus increase the intensification of research on tools intended for processing these materials. In 2020, the global diamond tools market size was valued at USD 15,154.7 million and is estimated to grow at a CAGR of 7.1% during 2021-2027. Expansion in the construction industry is expected to shape worldwide demand for diamond tools in the future years. Newly construction buildings with continuing construction necessitate the use of diamond tools to smooth and finish floors, walls and other areas, which significantly increases the demand for diamond tools. Similarly, the increasing production of automobiles creates the profit potential for the diamond tools market, which is used to execute critical operations on engine blocks, engine heads and cylinder block galleries, among other things. Advances in electronics manufacturing have also significantly expanded the scope of their applications, as has the development of metal bond technology and advancements in powder metallurgy.

In the field of research on tool materials used for precision machining, current major research efforts focus on extending their durability and performance. Therefore, as part of the proposed project, new groups of multiphase alloys based on the Fe-Mn system with the addition of alloy powders from the Fe-Cr-Mo-Cu-Ni system, will be developed as a matrix material in sintered metallic-diamond tools. The scientific goal of the project primarily includes the description of the kinetics and phase transformations occurring in the matrix material in order to reveal changes in their structure and the assessment of their impact on the material properties. Achieving this goal will be possible by understanding the relationship between the material microstructure, resulting from heat treatment and the process of nucleation and growth of reinforcing phases in the matrix materials, which is the essence of the project. Therefore, the proposed project supplements the current the state-of-the-art regarding the basic phenomena controlling the process of structure formation in multiphase alloys from the Fe-Mn system, which undergo significant strengthening as a result of phase transformation occurring during heat treatment. The effect of the research will be the establishment of the basic relationship between process, structure and properties, providing a practical recommendations for the large-scale production of such materials. We believe that the new materials obtained according to the technological approach we have proposed will be characterized by high strength, wear resistance, and will have high application potential, especially in the field of processing building and natural stone materials.

The project is expected to have synergistic effects leading to innovative results that may have implications for both industry and science. A better understanding of the shaping of the microstructure and functional properties of multiphase alloys will allow for a more conscious design of tool materials with enhanced strength and wear resistance, thereby expanding their range of applications.