

CERAMIC CUTTING TOOLS: A PROMISING ADVANCEMENT FOR ENHANCED MACHINING EFFICIENCY AND PERFORMANCE

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One of the main trends in the development of modern engineering production is to increase its efficiency and produce competitive engineering products. In this regard, high demands are placed on the cutting tool in terms of strength and reliability of its operation for a given period of time. The strategic direction of development of cutting tools is the development of new promising materials with a high level of physical, chemical and performance properties, the creation of technologies for their production. It is known that in mechanical engineering and other industries, labor productivity and the quality of processing of machine parts largely depend on the type of material used in machining process. The choice of material for the cutting tool has been a priority task of science and technology over the centuries. The practical use of cutting tool materials occurred sequentially in accordance with the development of metallurgy (hereinafter powder metallurgy): carbon steels - alloy steels - high-speed steels - tungsten-containing hard alloys - refractory compounds - ceramics - layered materials [1].

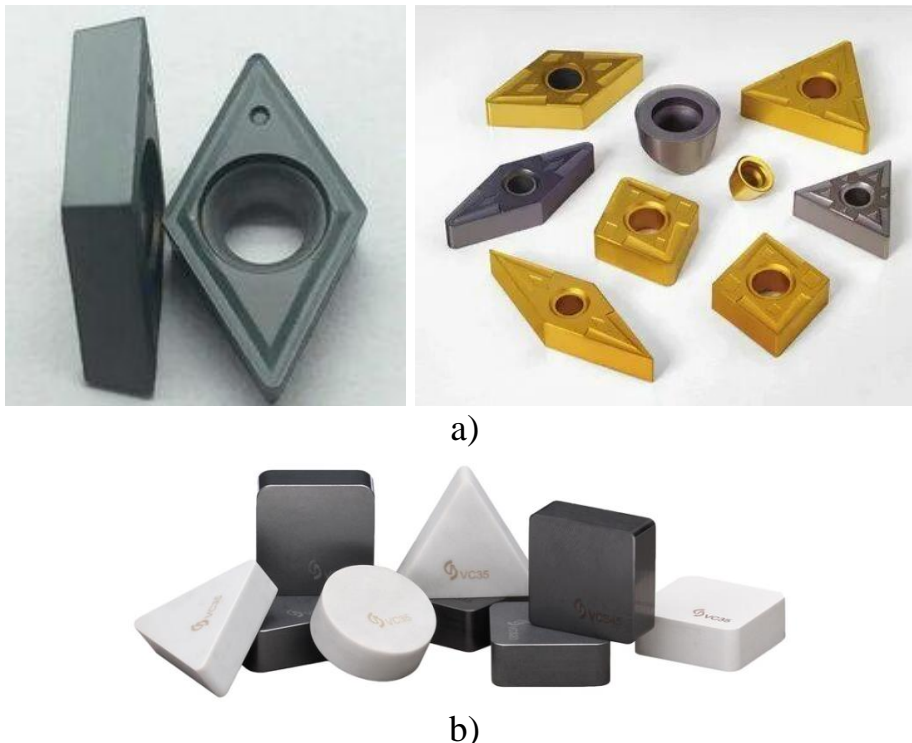


Figure 1. Ceramic tool inserts a) hard alloys; b) aluminum oxide and silicon nitride.

Cutting ceramics are qualitatively new tool materials. Such tools can accurately process parts of any complex shape made from materials with increased



strength characteristics and special properties, including hardened steels, heat-resistant alloys, difficult-to-cut cast irons, non-ferrous metals and abrasive non-metallic materials. Various types of ceramic materials can be used in engineering processes. However, among them aluminum oxide (Al_2O_3) and silicon nitride (Si_3N_4) based ceramic materials are considered high effective as cutting tool materials. Because, they have high fracture toughness, strength, good thermal shock resistance and low coefficient of thermal expansion as well as maintaining hot hardness at elevated temperatures [2-3].

Cutting ceramics based on alumina oxide appeared during 1940-1950 years, in comparison with hard alloys, tool and high-speed steels, has increased heat resistance and chemical stability, which allows it to be used for high-speed cutting. The cheapness and availability of raw materials give reason to consider cutting ceramics one of the promising tool materials, the proportion of which in metalworking is constantly increasing [4-5].

Conclusion. However, the widespread use of these materials in machine-building enterprises is hampered by their fragility, cutting ceramics are very sensitive to vibrations during cutting, and there are also difficulties in using them for processing with large cut thicknesses and interrupted cutting. Many researchers are working on development of ways and methods to increase the strength and toughness of ceramics.

References

1. Carter, B., Norton, M.G., & Wang, L. (2013). Ceramic Materials: Science and Engineering. Ceramic Materials.
2. Гнесин Г.Г., Осипова И.И., Ронталь Г.Д., Самойлов В.С., Ярошенко В.П. Керамические инструментальные материалы. [Ceramic tool materials]. 1991. ISBN: 5-335-00451-7.
3. Пронин А.И. Повышение работоспособности инструмента, оснащенного режущей керамикой и сверхтвёрдыми материалами. [Improving the performance of tools equipped with cutting ceramics and super-hard materials]. Диссертация. Комсомолскна-Амуре 1995.
4. Фадеев В.С. Научные основы разработки и получения слоистых композиционных материалов на поверхности твердых сплавов и оксидной керамики для повышения работоспособности режущего инструмента. [Scientific basis for the development and production of layered materials on the surface of hard alloys and oxide ceramics to improve the performance of cutting tools]. Диссертация. Якутск 2005.
5. Рисбеков С.С., Бектемиров Б.Ш. Zirconia toughened alumina (zta). Литье и металлургия 2019: сборник научных работ IV Международной научно-практической интернет конференции студентов и магистрантов. Минск: BNTU, 2019. С. 85-86.