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DEVELOPMENT AND MODERN TRENDS OF CERAMIC CUTTING TOOLS

Ceramic cutting tools have unique chemical and mechanical properties and could provide enhanced metal removal rates, increased tool life and the ability to machine hard materials. The advantages of using ceramic cutting tools are that hard materials with complex shapes can be processed in a single step, and surface grinding quality can be obtained by turning hard materials [1].

Toolingceramicsrequiredetailedstudyinordertoimprovepropertiessuchasfracture strength, impact toughness, heat resistance, hardness and wear resistance. Significant improvements in strength and impact toughness, and consequently in the overall performance of ceramic tools, have been made possible by several approaches that have been successfully applied. The sinter ability, microstructure, strength and impact toughness of Al_2O_3 ceramics were improved to some extent by the addition of TiO_22 and MgO, while enhanced transformation was achieved by adding appropriate amounts of partially or fully stabilized zirconium dioxide to the Al_2O_3 powder. Addition of TiC type carbide (5-15%) to Al_2O_3 powder imparts strength and thermal conductivity, and reinforcement of oxide or nitride ceramics with SiC filamentous crystals, which improve strength, impact toughness and tool life, leads to a significant increase in the performance of tool ceramics [2].

One of the promising methods under experimentation is the hardening of Al_2O_3 ceramics by adding a suitable metal such as silver; by imparting thermal conductivity and self-lubricating properties, this method is cost-effective.

It is known that determining the corrects interring technology is an important step in the production of tool ceramics. Isostatic and hot isostatic pressing have been successfully introduced into the molding process of ceramic tool systems. The introduction of nitride ceramics (Si3N4) with the choice of optimal sintering technology requires further research – this material is very strong, but prone to build-up during steel processing. A promising and successful method of ceramic moulding is the method of direct current transmission. Thus, in [3] it is reported about sintering of WC nanoparticles by this method using a hot vacuum pressing device. During high-temperature sintering under load the WC grain size increased insignificantly, remaining mostly less than 1 μm. At the same time, there is practically no porosity in the materials. That is why high values of flexural strength σ_{vizr} = 720 MPa were obtained. In this case, a high value of fracture toughness K_{1c}, which is important for

cutting tool ceramics, could also be expected with a high value of HRA. The increase of fracture toughness of such material can be explained on the basis of the known model of increase of K_{1c} in polycrystalline materials, namely by the joint action of two factors: highly dispersed grains and low strength boundaries both between grains below 1 μm and between coarser ones.

To conclude, the main wear mechanisms of ceramic cutting tools are abrasion, adhesion, diffusion, plastic deformation and fracture. Improving the performance of ceramic tools can be achieved by adding ZrO_2, TiO_2, MgO and TiC to the Al_2O_3 composition and reinforcing oxide or nitride ceramics with SiC filamentous crystals. The choice of the optimal sintering technique is an important step in the moulding of ceramic cutting tools. The sintering of WC-based ceramics by direct current transmition using a hot vacuum pressing device allowed to obtain high-density products with high physical and mechanical properties.

References

1. Senthil Kumar; A. Raja Durai; T. Sornakumar.Wear behavior of alumin a based ceramic cutting tools on machining steels. 39 (3), 191–197. 2006.doi:10.1016/j.triboint.2005.01.021

2. Tillmann W. Advancesin Brazing: Brazing of cutting materials. 423–471. 2013. doi:10.1533/9780857096500.3.423

3. Gevorkyan E., Morozova O., Chyshkala V., Nerubatskyia V. Nanostructured materials compacted via hot pressing method by direct current transmission.8th InternationalMaterialsScienceConferenceHighMatTech-2023. 2-6 October 2023, Kyiv, Ukraine.

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ФУНДАМЕНТАЛЬНЕ ЗНАЧЕННЯ ОЦІНКИ РИЗИКІВ ДЛЯ УПРАВЛІННЯ ОРГАНІЗАЦІЄЮ НА ВСІХ РІВНЯХ

Єдиною та основною ознакою наявності безпеки професійної діяльності є усунення ймовірності виникнення ризику пошкодження здоров’я.

Проблема професійної безпеки працюючої людини не може бути якісно розв'язана тільки шляхом технологічних інновацій. Сучасні технологічні процеси та конкуренція на ринку стрімко змінюють умови праці, створюючи нові небезпеки для здоров’я працівників. Одним з найважливіших аспектів наукових