DESIGN, PRODUCTION, MAINTENANCE AND DIAGNOSTICS OF AVIATION TECHNIQUE AND GASTURBINE UNITS

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Co-TiC CEMENTED CARBIDES. STRUCTURAL ASPECT

To increase wear resistance of turbine blades top shrouds plates made of different cast alloys are used. For this task current paper proposes Co-TiC cemented carbides. To evaluate prospective of their use in gas turbines it is necessary analize their microstructure and compare it with other alloys, particularly with industrial cast eutectic alloy XTH-62 and alloy P-69 [1].

Both cast alloys structure is obtained due to crystallization of carbides solution in cobalt. As far as titanium (niobium) and carbon are introduced as separate phases, it takes some time to full reaction running. The primary carbides solidification starts much earlier then that of binder. This process runs until the level of solubility of carbides in liquid phase. This leads to significant growth of their size (up to 30 μm) and nonuniform distribution through the alloy. The cracks in these grains are clearly seen. As volume rate of carbides in binder increases, TiC (for P-69) and NbC (for XTH-62) grain growth up to 60μm is observed. It is also necessary to mention, that 30% vol. of carbides in eutectic alloys is limiting and require elaborate manufacturing procedures due to high "viscosity" of a melt.

During binder solidification smaller (secondary) grains of 0.5–2 μm size appear. Their quantity is predetermined by solubility level of carbides in molten cobalt and can hardly be changed significantly.

To increase wear resistance it is necessary to increase carbides volume fraction in the alloy. It is possible using methods of powder metallurgy only. To produce bulk product powders of TiC are more preferable. Comparing to NbC they have higher hardness, heat resistance and is commonly used to produce some cutting tools for general engineering. High energy ball milling provides initial mixture of enough amount of fine TiC grains. Application of powder metallurgy methods also allows to decrease material consumption during manufacturing and to cut expendages.

Powder alloy P-76 containing 50% (vol.) of TiC is characterized by uniform carbides distribution through the alloy. Grain size varies from 0.5 μm up to 20 μm with no cracks. Pore size seldom rises to critical (6–12 μm) [2], it's density is as high as 97% of theoretical.

Conclusions: powder alloy P-76 has a uniform microstructure and almost free of porosity. This will provide its high strength and wear resistance.

References

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