

PRODUCTION OF TITANIUM – MATRIX COMPOSITES STRENGTHENED WITH SUBMICRON CARBIDE PARTICLES VIA MECHANICAL ACTIVATION OF TITANIUM POWDER IN TOLUENE MEDIA*

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High-strength titanium alloys are produced by doping with various metal additives (aluminum, vanadium, etc.). The dopants dissolve in titanium lattice resulting in solid solution strengthening. Another way to increase the strength of titanium alloys is the doping of titanium with non-metallic elements (carbon, boron, silicon). In this case, the strengthening effect occurs due to dispersed hard particles of refractory compounds (carbide, boride silicide) formed in the titanium matrix via reaction of titanium with the non-metallic dopants. The titanium matrix composites, strengthened with submicron or nano-sized carbide particles, have a suitable combination of strength and plasticity.

We have offered a novel production route of titanium matrix composites with titanium carbide hardening based on intensive mechanical treatment of titanium powder in hydrocarbon liquids (ethanol, heptane, toluene and so on) media. It is known [1, 2], that destruction of hydrocarbon molecules occurs in the course of titanium powder treatment in a planetary ball mill. Released carbon and hydrogen atoms incorporate into titanium and form carbide and carbohydride particles in the titanium matrix in the course of subsequent heat treatment. An additional vacuum heating is used to remove hydrogen from the mechanically activated titanium powder. While of the high temperature vacuum treatment, the carbohydrides are converted to nonstoichiometric titanium carbides. The resulting structure of the titanium matrix composite is shown on Figure 1b. Depending on the treatment duration an extent of hydrocarbon destruction enlarges, which leads to an increase in the carbon and hydrogen concentration in the reaction volume. In this way, a volume fraction of carbide particles in the titanium matrix can be regulated.

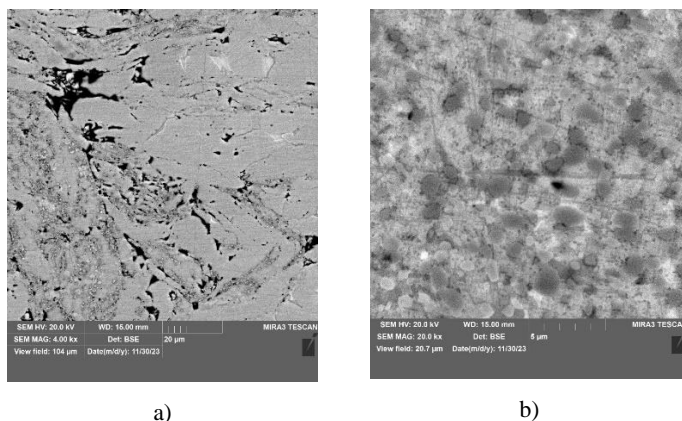


Fig. 1. Microstructure of hot compacted titanium powder mechanically activated in toluene media for: a) – 5 min, b) – 30 min. Before hot compacting, the powder was annealed in vacuum for 4 hours at 800 °C.

REFERENCES

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