SLM TECHNOLOGY PROBLEMS FOR METAL-MATRIX COMPOSITE FABRICATION

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Metal-matrix composites (MMC) possess an unique combination of hardness, fracture toughness and wear resistance.Therefore MMCcommonly used for wear resistant coatings. MMC structure consists of disperse hard inclusions uniformly arranged in a metal matrix. Titanium carbide is the most often used as a disperse strengthening phase in MMC. The reasons are extremely high hardness among the metal carbides and equal axes, rounded shape of the inclusions. Titanium, cobalt, iron and nickel alloys are used as the metal matrix in the titanium carbide base MMC. The most commercial interest for wear resistant coatings areTiC-Ti metal-matrix composites. TiC inclusions in Ti or in Ti alloy matrix multiple reduce wear as compared with titanium or alloys. There are a lot of publications on laser induced deposition of titanium and titanium carbide powder mixtures on the titanium base. The results of the investigations are a good background for additive technology application to TiC-Ti composite materials. To get a high strength together with high wear resistance it is enough “to print”TiC - Ti surface layer on volume fraction of the part printed of high strength titanium alloy. As a rule TiC and Ti use as a powder admixtures in additive technologies. Powder additives either put on base surface in a thin layer shape for following fusion or are poureddirectly into molten pool. In the most cases primary TiC particles dissolve in the liquid melt and precipitate at the cooling from Ti – C liquid solution in dendrite or equal axes crystals form.

A size and morphology of the carbide inclusions depend strongly on the molten bath cooling rate.When TiC – Ti powder mixes are poured into the molten pool a segregation of TiC and Ti powders can occur owing to difference in density and dispersity of the carbide and titanium powders. To avoid the powder components segregation they use composite powders instead of particular powder mixtures.There are some different methods to fabricate TiC–Ti composite powders. One of them is sputtering of TiC–Ti suspension in any organic liquid. Drying of the suspension drops in a hot gas flow results in solid granules formation. The granules (composite powders) consist of TiC and Ti particles uniformly distributed over granule volume. A mechanical treatment of TiC–Ti powder mixtures in planetaty grinding mills is used in another method of composite powder fabrication.

Self-propagating high tempertature synthesis (SHS) is the most high-productive and energy-saving technology for “TiC–Me” composites production. SHS in titanium and carbon powder mixtures results in TiC +Ti composite production when there is a titanium excess in the reactive mixture. After crashing and following screening of the porous SHS cake granules consisting of TiC particles in Ti matrix can be obtained. The granules can be used in selective laser melting (SLM) additive technology to get hard and wear resistant coating on the surface of titanium alloy part.