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PROTECTIVE HEAT RESISTANT COATING FOR INCONEL 718 ADDITIVELY MANUFACTURED PARTS

Abstract

The operating conditions of liquid-propellant rocket engines are extreme, so the demands for the materials for their manufacturing are specific and high. The heat resistant Ni-Cr alloys have the combination of necessary properties. However, during the engine operation the probability of flame development occurs due to the high temperature metal gas erosion in high pressure and temperature oxygen environment. The implementation of protective coatings for metals results in the increasing of parts quality and durability in operating conditions that include high temperature as well as aggressive gas and liquids environments. The protective coatings prevent the oxidation and burning of alloying element on grains boundaries and surface. Such effect leads to increasing of liquid-propellant rocket engines operating temperatures that is directly connected with power and efficiency increasing. The 3D printing for engine's parts manufacturing results in not only obvious economic and technological advantages but also leads to the necessity of new heat-resistant coatings development. The goal of present work was the development of new protective heat-resistant coating for 3D printed Inconel 718 parts. The first stage of development was the evaluation the proper basis glass base that makes technologically possible the protective coating obtaining with pre-defined firing temperature-time mode. It is known, that coating's qualitative characteristics such as adhesion, density and others are strongly dependent from thermal expansion coefficient value, viscosity and surface tension of basis glass. The analysis of obtained properties complex makes possible to choose and recommend the using of BaO-ZnO-B2O3-Al2O3-SiO2 as a base glass system. The further development steps determined the optimum working conditions of slurry such as milling fineness, consistency and moisture content. The influence of coating thickness and firing temperature-time modes on coating's main operating properties and Inconel 718 parts protecting efficiency has been determined as well. As a result, the defects-free coating with high adhesion to metal substrate, wide operating temperature range (from -183° to +1000°) and resistance to vibrations and gas corrosion has been developed.