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Synthesis and characterization of glass-ceramic-metal composite materials obtained by sintering

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The industry's progress is closely connected with the development of new materials. Complex industrial systems, such as thermal power plants, pose a significant challenge in terms of maintenance as well as achieving high performance of machine elements and structures that operate under conditions of different damage mechanisms. For that reason, new materials are constantly being developed, which, in addition to good physical and mechanical properties, today must also meet ecological criteria, and economic viability. The aim of this paper is the synthesis of new glass-ceramic-metal composite materials and their characterization.
Andesite basalt rock from the deposit site "Donje Jarinje", Serbia, was used as a starting material for obtaining a glass-ceramic matrix of composite materials. The rock was milled in a tungsten-carbide vibrating cup mill to obtain the fine powder suitable for synthesis. Commercial austenitic stainless steel 316L, spherical shape, was used as reinforcement in composite materials. The diameter of 316L powder is in the range from 45 to 90 μm.
The composite materials were manufactured by mechanical mixing andesite basalt powder with 316L powder in the contents of 10, 20, and 30 wt.%. Paraffin wax was used as a binder in the content of 0.6 wt.%. After homogenization of the powders and binder, the green compacts were obtained by single-side pressing about 50 MPa, a then cold isostatic pressing about 230 MPa to increase the density of the green compacts. Sintering was performed at 1060 °C for 60 min in the air.
The starting powders, and the sintered composite materials were characterized by the X-ray diffraction method (XRD). Morphology of the powders and microstructure of the sintered samples were observed by a scanning electron microscope (SEM) and a light optical microscope (LOM). After the characterization, the obtained glass-ceramic-metal composite materials were confirmed.