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The effect of nickel coating on the properties of Cu-SiC composites

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Due to their properties, copper-silicon carbide composites can be potentially used as heat dissipation elements in electronic circuits. Their possible areas of application depend on the material properties, which are inextricably linked with the quality of the metal-ceramic interface. The annealing of the copper and silicon carbide at high temperatures leads to a chemical reaction in the contact area. Hence decomposition of silicon carbide's occurs, which leads to dissolution of silicon in copper and formation of a carbon layer on the SiC surface. Such changes exert a negative influence on the heat transfer capacity of a given material. Therefore, the protection of the surface of silicon carbide from decomposition is a key issue in view of production of the Cu-SiC composite materials. The choice of a suitable coating type should ideally ensure its durable coupling with both copper and silicon carbide, and its properties should not have a destructive impact on the characteristics of the entire composite.
As part of experimental technological tasks, a thin layer of nickel was produced on SiC grains using the plasma vapour deposition method (PVD) to protect silicon carbide. Next, after being mixed with copper powder, SiC grains were sintered applying the spark plasma sintering technique (SPS). Sintering performed at 950C made it possible to achieve materials with a high relative density (>97.5%). Scanning electron microscopy and transmission electron microscopy were used to investigate the structure around the interface. In addition, mechanical and thermal properties (e.g. thermal expansion coefficient and thermal conductivity) of composites with a varying ceramic phase content were studied. The composites characterized by uncoated silicon carbide were used as the reference material. It was shown that composites with nickel coating improves their properties in relation to pure one.