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The effectiveness of prevailing plasma spray conditions in the synthesis of protective coatings

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Protective coatings of different composition are widely used in diverse fields of industry including a modification of surface layers of constructional materials. Mechanisms of film formation in plasma spray processes are not investigated thoroughly. It is not determined how the parameters of process influence the quality, specific surface area, thickness and adhesion of coatings. Therefore the investigation of the influence of formation technology on structure and properties of protective metallic and ceramic coatings is the main objective of present work.
Coatings in the present study were deposited employing a specific plasma spray technique with a linear, sectional plasma torch 50 kW of power generating non-equilibrium plasma jet at atmospheric pressure. Plasma stream reactor was connected to the plasma torch exhaust nozzle. Experiments were performed at plasma flow temperature 2500 – 3500 K and velocity 350 – 500 m/s. The structure of coatings was evaluated from the top-view and cross-sectional scanning electron microscopy observation and the surface phase composition was analyzed by X-ray diffractometer. Depending on plasma process regime (arc current, voltage and plasma forming gas flow rate), films of 30 – 90 micrometers in thickness were formed from Ni and Cr containing powder mixture. The similar coatings were deposited using ceramic powder mixture containing aluminum hydroxide, dolomite and quartz sand.
It has been found that the shape and size of the coating grains also depend on plasma source characteristics and gas flow rate. Under high plasma forming gas flow rate and low temperature in plasma chemical reactor, the feeding ceramic dispersed particles does not melt fully in the same time and may be carried out as partly melted and agglomerated granules. The small amount of hydrogen improves the deposition efficiency, the plasma jet propagation and increases the energy transfer.

Keywords
plasma spraying
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deposition of coatings