Mechanical and tribological properties of Ni-B/boron composite coatings produced by chemical reduction method

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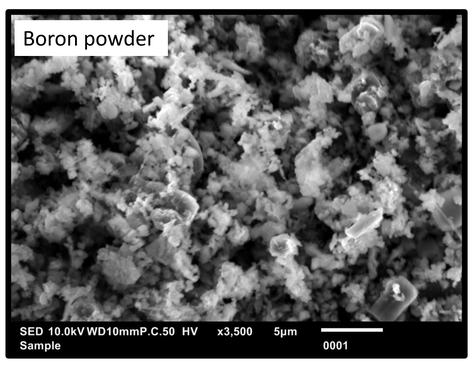
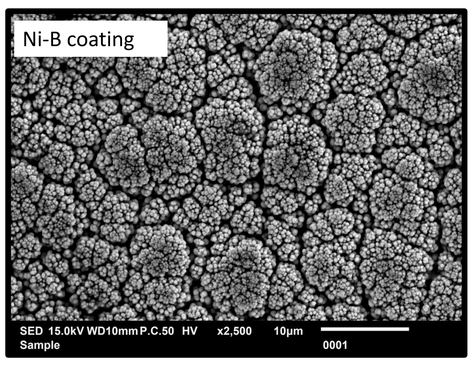
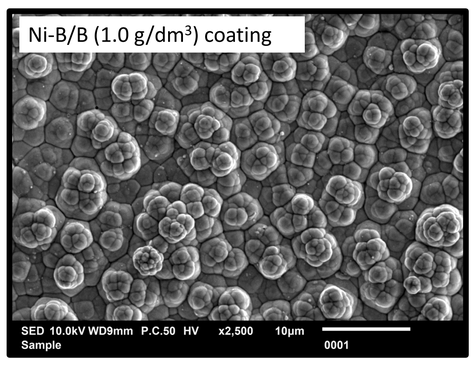
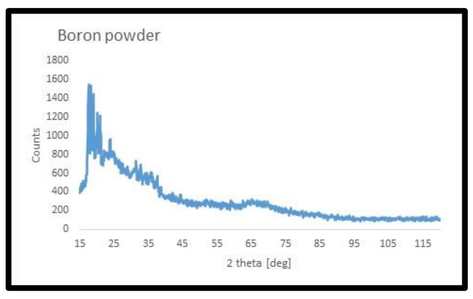
The paper presents the results of research on composite Ni-B coatings with embedded particles of boron produced by chemical reduction method and their influence on the mechanical and tribological properties of produced materials. Boron was used in two forms: an alloy component and nanoparticles incorporated into the Ni-B matrix. The coatings were deposited from a bath at different concentrations of dispersion phase, namely 0; 0.1; 0.5; 1.0 g/dm^3. The deposition process was carried out at constant stirring speed of 100 rpm, bath temperature of 363 K, and deposition time of 90 minutes. The paper presents also the characteristics of the used boron particles. Results of morphology and surface topography (SEM) as well as the structure (XRD) of the produced coatings were presented. The mechanical properties of the produced coatings were tested by the Depth Sensing Indentation (DSI) method. The Knoop hardness, Martens hardness and indentation hardness as well as the modulus of elasticity of the produced coatings were determined. The tribological tests were carried out using the ball on disc method. The test was performed under dry friction conditions.

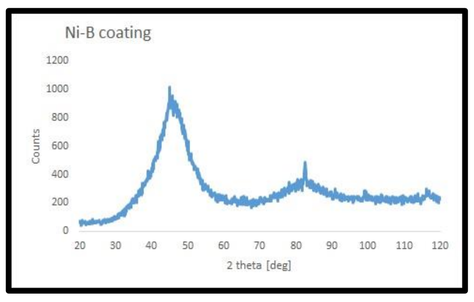


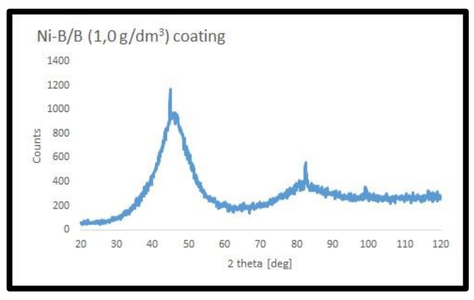




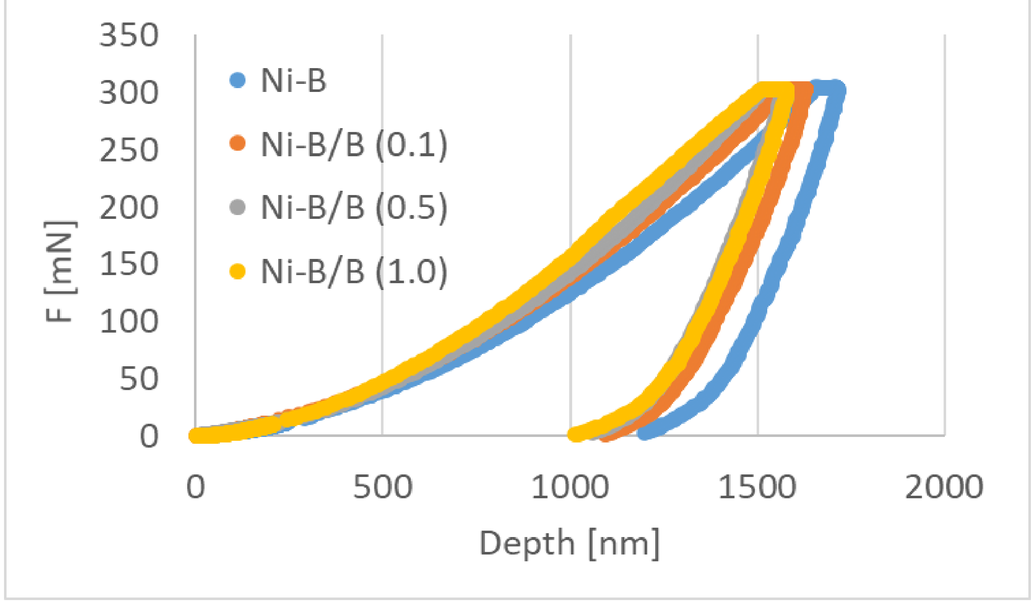
Coating	Microhardness		Elastic modulus E_{it}
	H_{IT} [MPa]	H_M [MPa]	[GPa]
Ni-B	5454	3919	130
Ni-B/B (0.1)	6194	4289	128
Ni-B/B (0.5)	6869	4812	150
Ni-B/B (1.0)	6408	4496	140

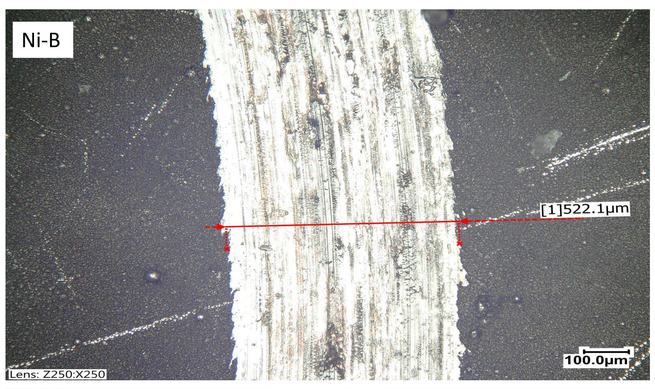


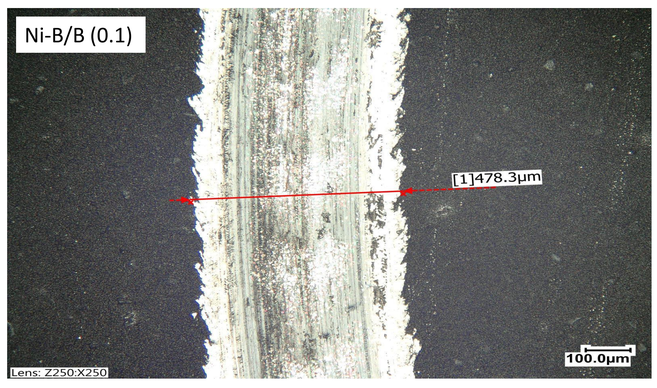


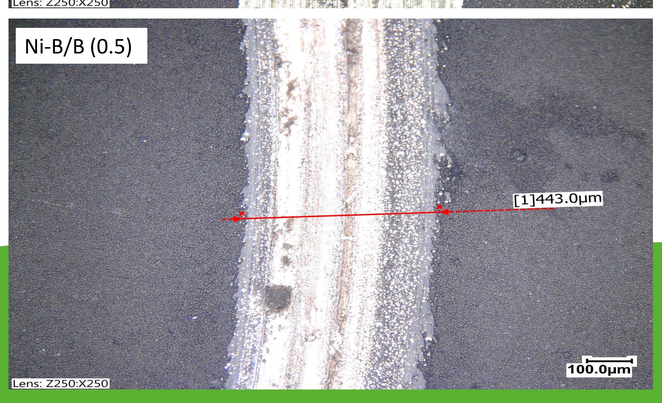


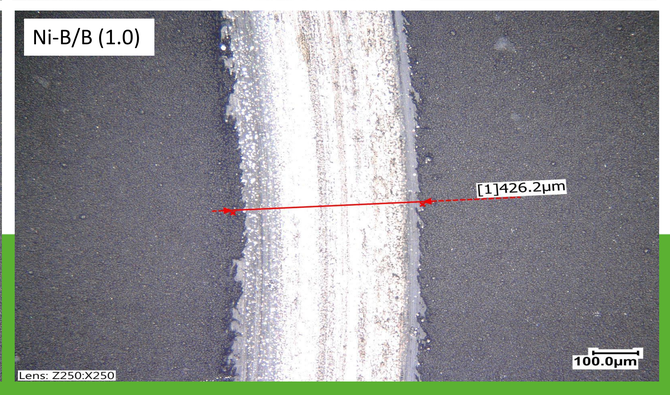
Coating	Friction Coefficient	Thickness [µm]	Roughness Ra [µm]
Ni-B	0.8277	23.6	0.707
Ni-B/B (0.1)	0.7618	19.7	0.700
Ni-B/B (0.5)	0.7203	13.6	0.591
Ni-B/B (1.0)	0.6879	15.6	0.460

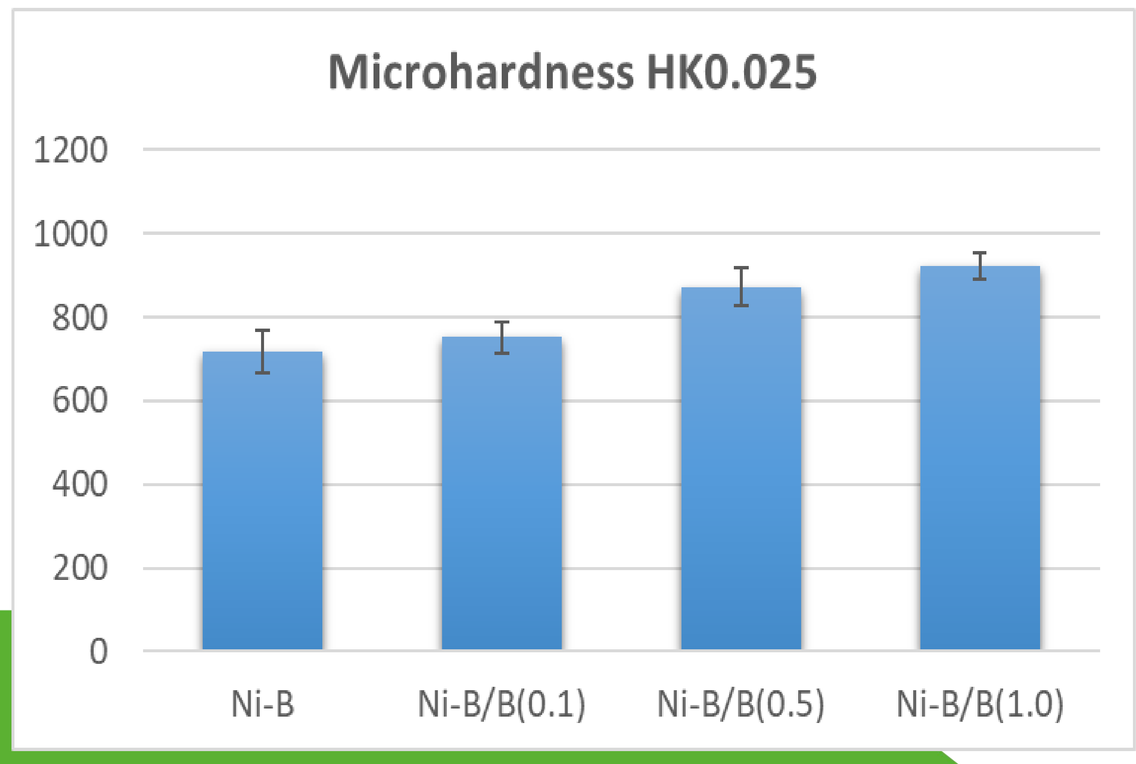












Composite coatings of Ni-B/B produced by chemical reduction method were studied. The incorporation of boron particles into a nickel-boron matrix affects the structure, morphology and properties of the produced composite coatings. The increase of B content in the bath contributes to decrease of the surface development degree and thickness of produced coatings. On the other hand it increases the tribological and mechanical properties of the produced Ni-B/B composite coatings. Composite coatings of Ni-B/B are characterized by a compact structure and a good adhesion to steel substrate. Coatings of this type can be used to cover metallic elements in order to improve their functional properties.

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