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Nanostructured thin films based on carbo-nitrides if transition metals with silicon additions resistant to wear

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The invention relates to preparation of nanostructured thin films based on carbo-nitrides consisted in one or more of transition metals with Si additions prepared by cathodic arc evaporation method used as protective films of cutting tools which ran under wear harsh regime by abrasion, erosion, and corrosion used in wood machining and cutting. Materials consist in complex carbo-nitrides based on Cr, Fe, Ti and W as base metal with elemental concentrations of min. 30 at.%, and max. of 30 at.% of C or N, and Si ranged from 2 to 12 at.%.

Deposition conditions for the coatings

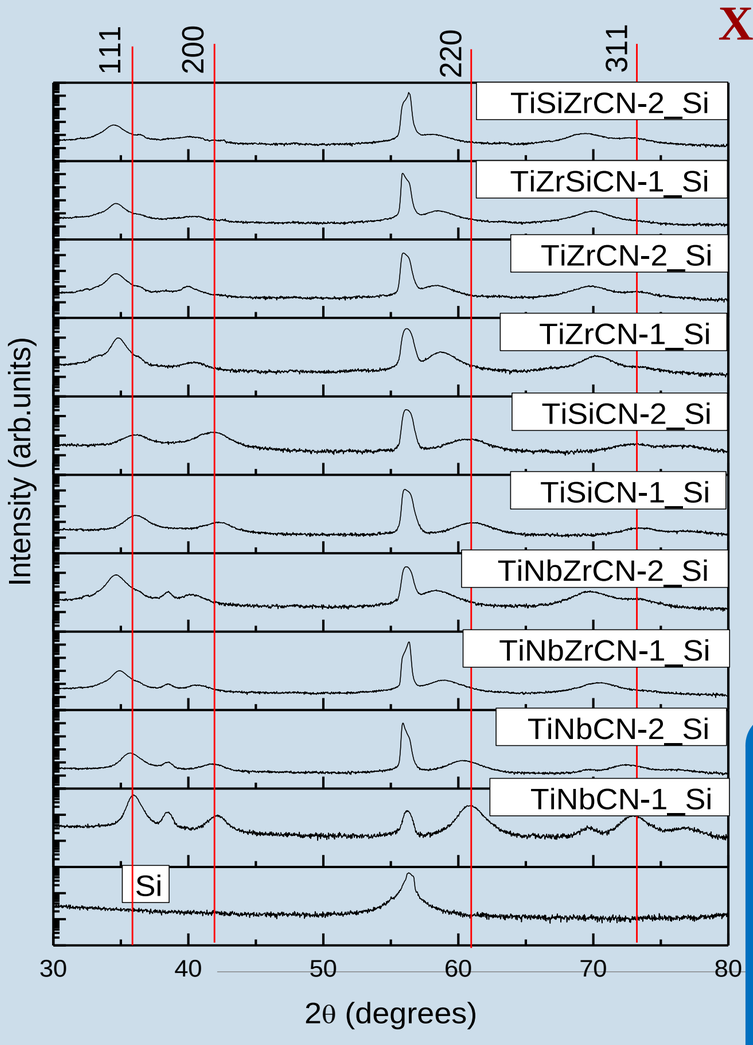
Total (CH_4+N_2) mass flow rate	90 sccm
CH_4 mass flow rate	25 sccm
N_2 mass flow rate	65 sccm
Arc current	90 A for Zr, 110 A for TiNb and TiSi
Substrate bias voltage	-100 V
Deposition temperature	320 °C
Deposition duration	40–50 min

TiZrCN
TiZrNbCN
TiZrSiCN

EDS

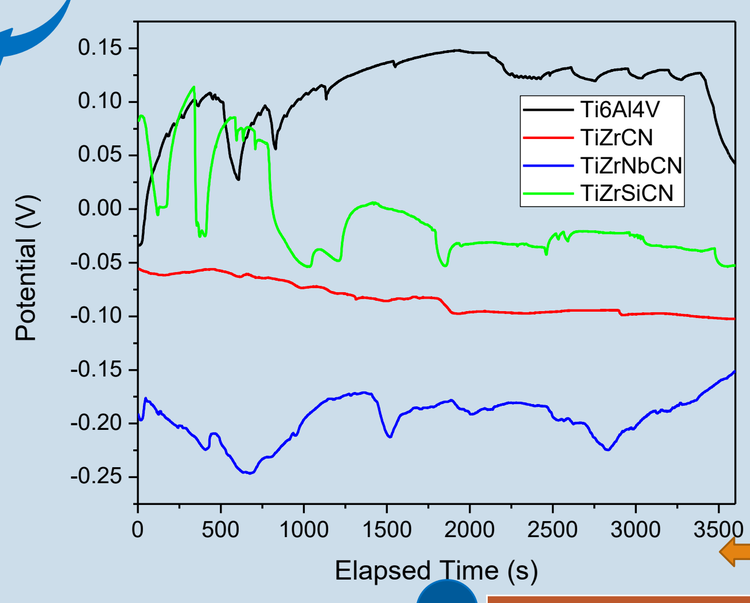
Coatings	Ti	Zr	Si	Nb	C	N	O	V	Al	C/N
TiZrCN	38.48	9.04	0	0	15.81	34.64	1.9	0	0.13	0.45
TiZrSiCN	34.55	8.82	4.64	0	15.66	34.12	2.11	0	0.10	0.45
TiZrNbCN	34.73	8.74	0	5.48	14.73	34.06	2.18	0	0.08	0.43

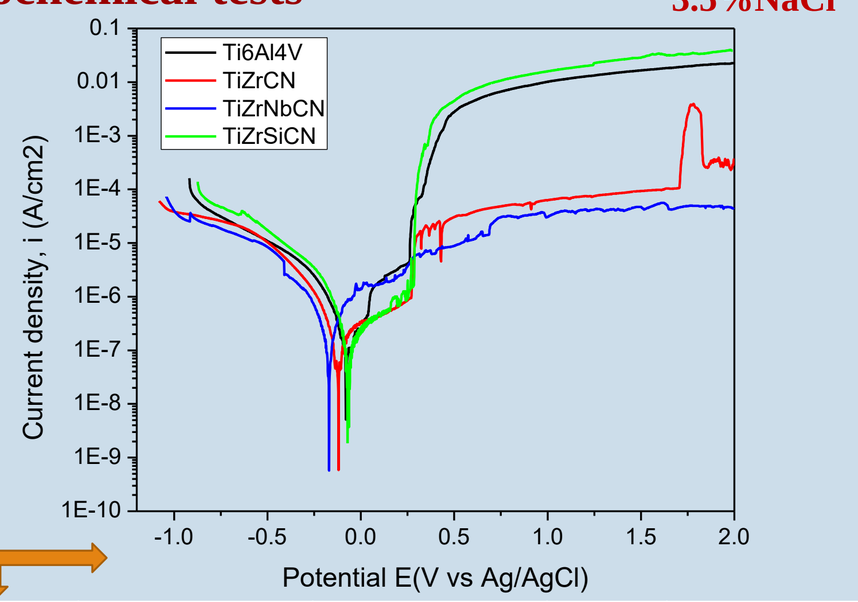
XRD



Electrochemical tests

3.5%NaCl





Electrochemical parameters of the investigated samples: E_{corr}: corrosion potential; i_{corr}: corrosion current density; R_p: polarization resistance; P: porosity; P_e: protective efficiency

	E_{corr} (mV)	i_{corr} (nA)	Rp (Ω*10^3)	Pe (%)	P
Ti6Al4V	-78	222.123	193.93		-
TiZrCN	-122	36.77	1523.12	83.5	0.113
TiZrNbCN	-170	91.228	579.76	59.9	0.262
TiZrSiCN	-67	16.01	2618.50	92.7	0.0719

Roughness parameters (R_a –arithmetic average deviation from the mean line (a); S_k – skewness (b)) of investigated samples before corrosion and after corrosion

SEM micrograph and elements mapping analysis of TiZrSiCN samples: [a1] before corrosion and [a2] after corrosion

SEM micrograph and elements mapping analysis of TiZrCN samples: [b1] before corrosion and [b2] after corrosion

SEM micrograph and elements mapping analysis of TiZrNbCN coatings: [c1] before corrosion and [c2] after corrosion

SEM micrograph and elements mapping analysis of TiNbCN coatings: [c1] before corrosion and [c2] after corrosion

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