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EFFECT OF NITROGEN PIII IN THE CHEMICAL COMPOSITION OF AISI SS304 SURFACES

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INTRODUCTION

- Plasma immersion ion implantation (PIII) is a widely used technique for the surface modification of materials, looking mainly for improvements of mechanical, electric or magnetic properties of complex-shaped 3D objects .
- The success of the treatment is usually related with the implantation of a high dose of ions and/or the achievement of a moderate temperature of the substrate during the process, to enhance diffusion.
- Nitrogen PIII processing inside SS tubes, with and without magnetic Field (B) was studied.
- Besides the plasma parameters, the substrate chemical composition is strongly influenced by characteristics of the treatment and modification of the treated surface.
- X-ray photoelectron spectroscopy (XPS) has usually been used for the investigation of the chemical changes occurring on the near-surface region.
- We carry out a study to show the usefulness of XPS to analyze the effect of the nitrogen on the PIII treated SS304 surface layers.

EXPERIMENTAL

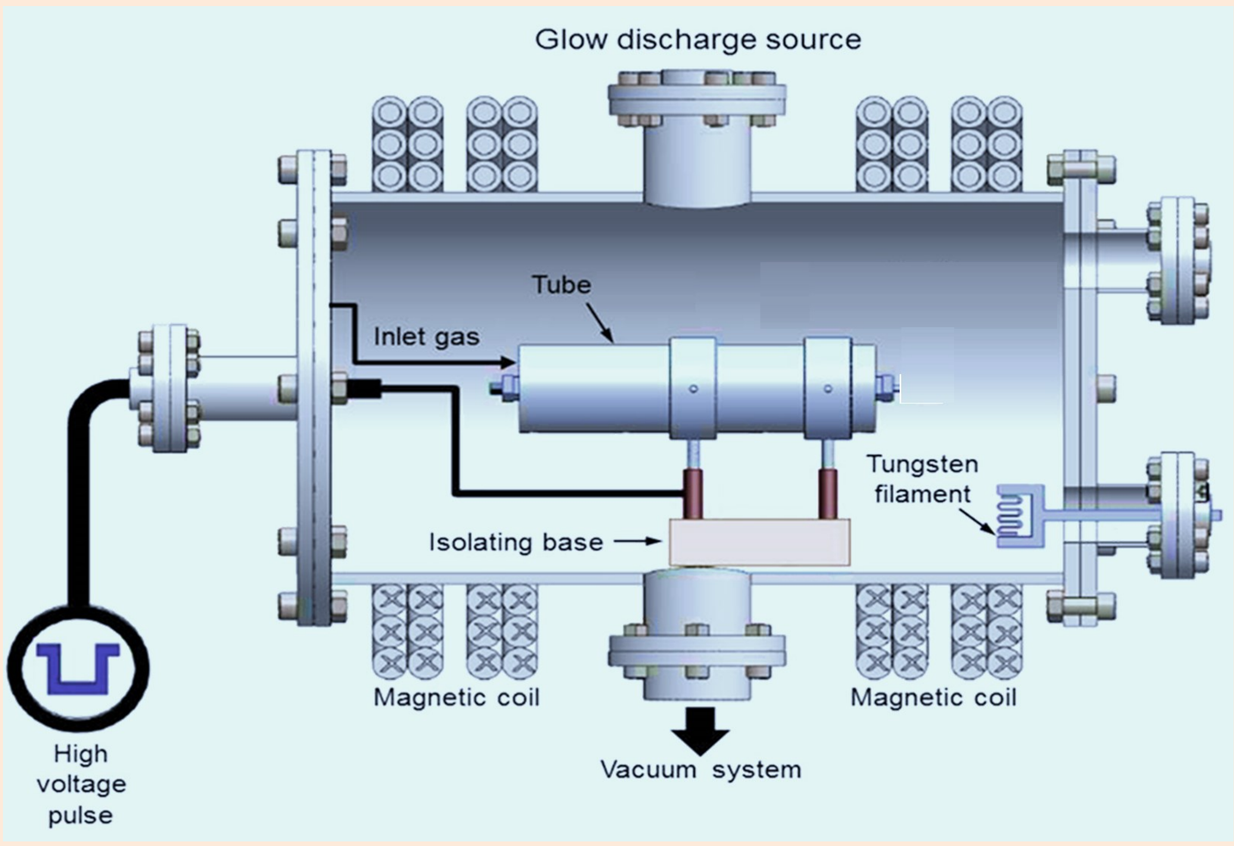
SS 304 Substrate
3 mm Thickness
10 mm Diameter

Nitrogen PIII
6 kV – 500 Hz
60 min - 20 μs
3 x 10^{-2} mbar

E Field and

E x B Field

Quantities	Tube: Diameter = 1.5 cm	
	Without B	With B
J (mA/cm²)	57	57
T (°C)	440	440

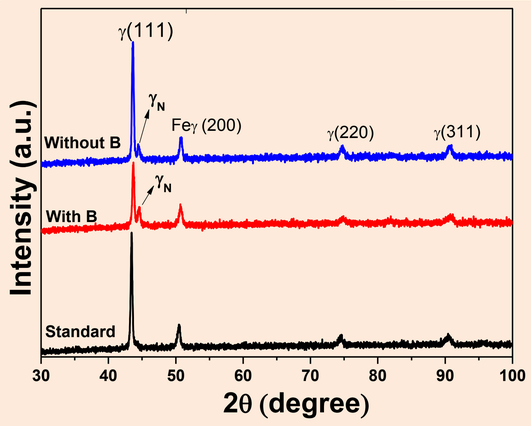


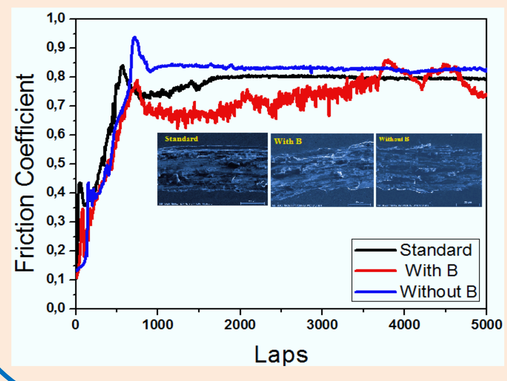
CONCLUSIONS

- XPS results revealed the presence of nitrogen adsorbed in SS304 surface and the new phases such as Fe_xN and Cr2N.
- Fe 2p spectrum showed a band at about 710.5 eV and corresponding to iron-oxide, evidencing the existence of a thin oxide layer on the sample.
- High concentration of nitrogen implanted into SS 304 confirming the efficiency of the PIII process in the tube.

RESULTS

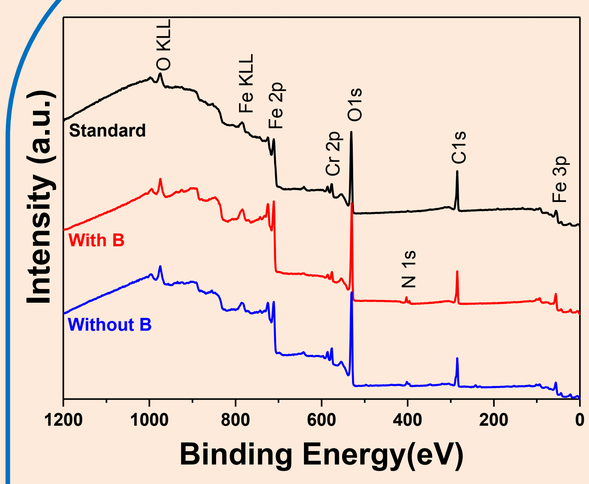
DRX and Friction Coefficient



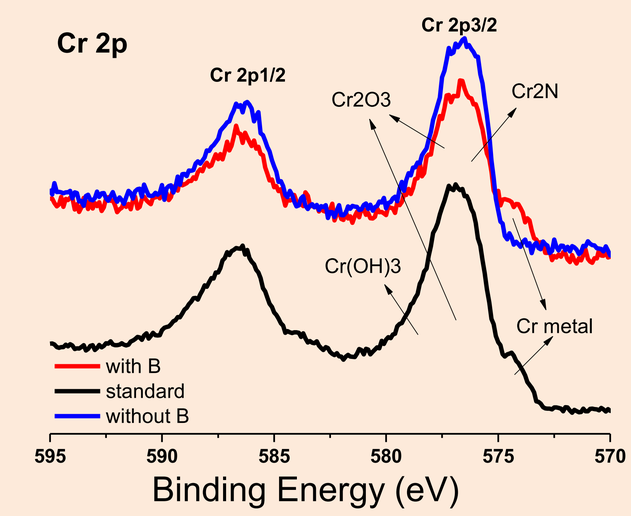


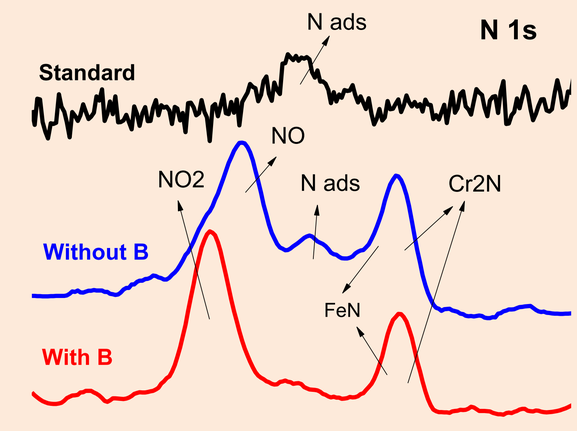
- ✓Strong diffusion effect occurred due to high temperature (440 °C) reached.
- ✓γ_N phase is related to the presence of N layer.
- ✓ Peaks of γ_N is present next to principal peak (γ_{111}).
- ✓A temperature of 440 °C was achieved due to the high current (57 mA/cm²) bombarding the tube inside wall.
- ✓Formation of low CrxN peak has resulted due to temperature.
- ✓ Nitrogen PIII with magnetic field decreases the friction coefficient.

XPS



(at. %)	C 1s	O 1s	N1s	Fe 2p	Cr 2p	Co 2p
Standard	47.18	40.85	0.92	9.75	1.30	-------
Etch (600s)	5.30	39.03	-----	29.6	7.57	4.10
Without B	34.28	43.68	2.47	13.62	0.80	--------
Etch (600s)	6.47	45.43	2.35	23.62	1.34	-------
With B	32.78	40.80	2.09	11.90	1.00	--------
Etch (600s)	7.97	48.48	**3.78**	18.9	1.25	1.78





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