Petróleo, Livre Mercado e Demandas Sociais

Número 5
Investimentos Necessários no Setor Elétrico: 1993-2010

Instituto Liberal
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ESTE TEXTO CONTOU COM A COLABORAÇÃO
DA PROP JENNIFER HERMANN
DA UNIVERSIDADE FEDERAL FLUMINENSE

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scans for all elements (Li to U) were acquired on the as-received surfaces. Depth profiles were obtained by alternating an acquisition cycle with a sputtering cycle. The sputtering cycles remove material from sample surface using a 4keV Ar$^+$ source rastered over a 3mmx3mm area. To eliminate crater-wall effect, the data were acquired from a smaller region in the center of the sputtered area. Typical results of AES analysis are shown in Figure 6.

Figure 6. AES analysis of sputter cleaned TiN sample, showing little oxygen or carbon contamination in the coated film and correct stoichiometric ratio of Ti to N.

3.2 Rutherford Backscattering (RBS)
RBS uses a 2-MeV He$^+$ ion beam as the probe. The analyzer detects backscattered ions at 120° and 160° from both aligned and nonaligned directions with typical accumulated charge of 50μC. The RBS spectra shown in Figure 7 provide precise information on coating thickness and composition. The Ti to N ratios were consistently in the 0.9-1.1 range with coating thickness of ~400nm after 3 hours of coating. The profile indicated that the energetic nitrogen and titanium penetrated the iron substrate and formed intermediate layers with thickness ranging from 20nm to 50nm.

Figure 7. RBS depth profiles of TiN coated coupon give quantitatively the distributions of nitrogen, titanium in the coatings

3.3 Secondary Electron Yield (SEY)
TiN-coated coupons were sent to colleagues at CERN for SEY measurements. Electron beam with energy between 60 and 3000eV bombards the surface at normal incidence angle. All secondary electrons are collected to derive the SEY [6]. The measurements were done as received, without in-situ bake and with very low current and accumulative dosage (down to nC/mm$^2$) to minimize surface modification effects, since SEY is strongly dependent on the dose of primary electrons [6]. The difference in SEY between uncoated and TiN coated samples is illustrated in Figure 8. Compared to the bare stainless steel, TiN layer has a significantly lower SEY.

Figure 8. SEY as a function of incidence electron energy for bare and TiN coated stainless steel. The coating reduces the SEY by about 30%.

4. SUMMARY
DC magnetron sputtering has been developed to coat the SNS ring vacuum chambers with TiN. The coating has correct stoichiometry, good adhesion and low SEY. The difficulties in producing a film with uniform properties within the long half cell chamber have been overcome with the development of a unique magnetron target. A production facility is being assembled to coat the large quantity of SNS production chambers.

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6. REFERENCES