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Surface Chemistry of Nano Austenitic Stainless Steel

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Abstract: Recently significant efforts have been concerned on comparing the standard cleaned for Ultra High Vacuum (UHV) and passivity Stainless. We have thus studied the nano structural properties of Austenitic Stainless Steel (ASS) (316L ASS) samples with using EDX (Energy Dispersive X – ray) technique. Type – 340 has more Cr content than that type – 320. The obtained results indicate that type – 340 can prevent structural corrosions and is therefore suitable for the future of UHV chamber generations.

Key words: Nano structure · Stainless steel · EDX technique and UHV chamber

INTRODUCTION

Chemical and physical of materials interfaces, surfaces and in particularly structures are important technological fields. But different scientific challenges are threatening the use of current ASS materials for growing the thinnest possible film. One of the problems for UHV chamber designers is the practical difficulty of detecting of the navel properties of nano crystalline ASS.

In addition, the growth of ultra thin films should be done at UHV condition in where, the base pressure is down to 10^{-12} Torr. As time passes engineers need to get lower pressure to be sure for growing ultra thin film (less than 1-2 nm) without any impurity and dirty.Henceforth the vacuum chamber should stand its mechanical structure and keep its stability to prevent corrosion.

In this work we got two different Ass samples, named 302 and 304 type with different chromium and carbon contents. The 304 Ass type is a variation of the basic 18-8 grade whilst type 302 includes a higher chromium and lower carbon content than 302 Ass can minimize the corrosion in UHV chamber structure. Corrosion it need to be annealed the samples in order to retain adequate corrosion resistance, but it has slightly lower mechanical properties than type 304 [1-6]. We found that if the flange is improperly covered with chromium oxide layer, the Ass surface is desirable to rust.

Experimental Procedure and Details: The stainless steel samples (3cm×1cm) were polished from one side to ensure a smooth surface. We rinsed them with ethanol and put them in an ultrasonic bath for one hour. The cleaned samples may be oxidized with oxygen molecules in the media or make bonds with carbon atoms, we cleaned them one more by passing current through the samples several times. Otherwise, the existence of ultra thin or thin layer of oxide layer on the sample surface can change the quality of the film grown inside the UHV chamber. For cleaning the sample and out gassing the chamber to get ultra high vacuum condition, we baked the chamber before the experiments in which after baking the background pressure can be down to 10^{-12} Torr.

Earlier, measurements with a residual gas mass spectrometer in the line of the beam, has shown that a very low proportion (about 5 percent) of oxygen and carbon is produced with this setup. Typical pressures in the chamber during experiments into the vacuum chamber were around 5 x 10^{-10} Torr. Indeed, nanotechnology and modern society demand better and more sophisticated materials for engineering as well as nano opto-electronic applications. In these area the dominate research topics are color marking on stainless steel and corrosion resistance.

Experimental Procedures and Discussions: The samples are type -302, type - 304 and /or 316L Ass 316L Ass chemical composition is

$$(in \frac{element\,Mas}{Ironmass} \times 10^{-3}):$$

$$\frac{Cr}{Fe} = 272/3, \frac{Ni}{Fe} = 181/1, \frac{Mo}{Fe} = 31$$

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$$\frac{Mn}{Fe} = 25/5, \frac{Si}{Fe} = 3/5$$

It also contains a little bit cupper sulfur and

$$\frac{C}{Fe} = 0/029$$

Whereas

$$\frac{(Cr)_{302}}{(Cr)_{304}} \approx 1.2$$

$$\frac{(Cr)_{302}}{(Cr)_{304}} = 0.3$$

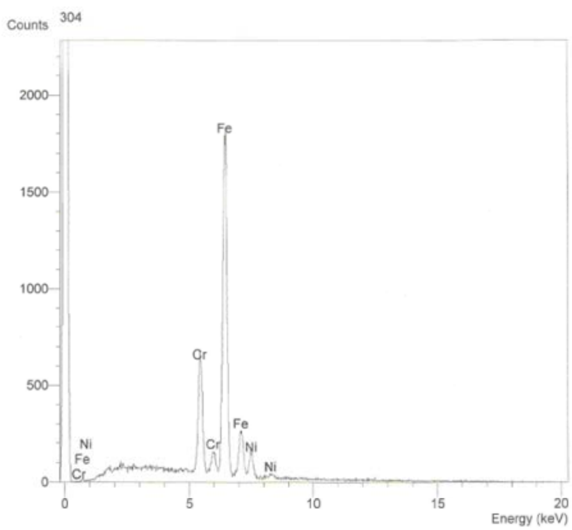

Fig. 1: The element intensity of stainless steel (type – 320 ASS).

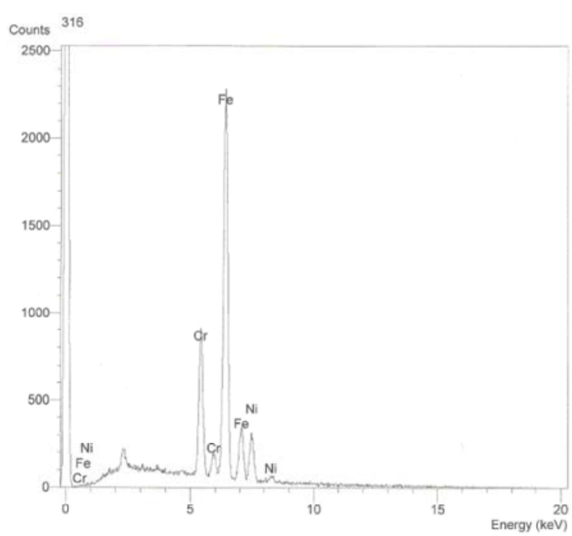

Fig. 2: The element intensity of stainless steel (type – 340 ASS).

To be confidence of what shown in Figs. 1 and 2, we get EDX spectra as seen in Figs. 1 and 2. It is clear that the huge peak in both EDX figures are peaks for k_{α}-transitions, whilst the other peaks beside huge peak are due to k_{β} -, k_{γ}- transitions. However, the background is not straight line, meaning for nano scale layer and film we need to fit ultra thin film spectrum with parabolic background line.

These figures reveal that the inter band and surface plasmon peaks are so small peaks. They affect on the chemical property of Ass and therefore they should be taken into account for describing the novel Ass nano structural properties.

As can be expected, the EDX signals are proportional to the structural anisotropy. And more significant as series progress to smaller and smaller scales in to the realm where even surface plasmon inter bands k_{β} and k_{α} transition's peaks make important contributing.

Comparing Figure 1 to 2, they imply resistances to staining, rusting and pitting in the general normal environment. Type - 340 has a higher resistance to corrosion with more Cr. Type- 340, in addition to better corrosion resistance, has high ductility and toughness as found in some studies [7-13]. In addition nickel in Ass can just partially improve the corrosion resistance strength and stabilization which is needed for the future discussions.

CONCLUSION

The main aim of the present work is to compare two types of stainless steel samples for finding suitable elemental composition of VHV chamber which is necessary for growing ultra thin film of the next nano electronic, nano medical and nano novel sensors devices.

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