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Corrosion Resistance of the Stainless Steel Nano Sructure

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Abstract: The stainless steel (SS) has been used as a material for building Ultra High Vacuum (UHV) Chamber. The nano crystalline phases of SS have been identified from XRD (X-Ray Diffraction) spectra. We have also studied the surface morphology of SS with using SEM (Scanning Electron Microscopy) technique. The obtained results show that some unwanted chemical bonds on the SS surface such as ultra thin chromium metallic film and an interlayer of conductive oxide film cause roughness variations and/or columnar-like shaped grains. These problems are due to the rebar surface condition on corrosion initiation. We thus study the effect corrosion on the nano structural properties of SS.

Key words: Nano Material · Nano Structure · Stainless Steel and Corrosion

INTRODUCTION

In the past decade, some researchers [1-7] have studied the nano crystalline materials due to their unique, superior corrosion resistance and hardness. However there are still many questions unanswered in the field of SS nano structures, meaning, scaling the characteristic size of crystalline down to the nano scale, the mechanical behavior of SS nano materials influence the outguessing and leakage current through the UHV chambers. We need to study SS properties, because the higher stability of UHV chamber is needed for growing the ultra thin film, like silicon nitride and metallic oxide films, for the future of integrated circuits (IC_s). In order to explore the unusual structure-property relationship in nano crystalline materials and to make use of nano crystallization, we should find a way to improve the properties and behavior of engineering materials. Although the corrosion propagation stage can change the mechanical properties of SS, the initiation stages assess the corrosion resistance which expresses the localized corrosion resistance of an alloy based on composition given by [8-12]. Therefore, the effect of SS surface conditions depletes chromium from the cited alloy and sometimes produces an outer layer. By adding Mo into SS, we guess to get lower corrosion resistance. Because of the loss of corrosion resistance on outer surface layers, most final SS products can be used in other applications.

EXPERIMENTAL RESULTS AND DISCUSSION

SS samples are polished from one side to ensure a smooth surface and cut out of 320 and 340 SS wafers. We rinsed them with ethanol and put them in an ultrasonic bath for one hour. The cleaned SS samples may be covered with ultra thin undesirable films in the media and/or make bonds with carbon atoms; we washed them with acetone just before transferring them into UHV chamber of SEM technique. Keep in mind that the chamber was baked before the experiments. After baking the background pressure inside UHV chamber was 2×10^{-7} torr.

Figures 1 and 2, two different type of the samples, type - 320 and type - 340 SS, show the formation of a less adherent and possibly anion selective oxide layer which exposes a chromium depleted steel surface for type 320 SS. These relatively layer difference in corrosion resistance of type 320 and type 340 SS with, of course, different composition (Cr for 320-type and Cr for 340-type is more contest that the other type) made using a uniform structure and less slits due to maturing of the 340-type passive film [8-18]. The passive film will continue to evolve throughout the lifetime of SS nano structural materials as the good material for the future of UHV chambers. However, aging involving defect annealing and the continued, relatively slow, oxidation of Fe^{2+} to Fe^{3+} in the outer layer of the oxide continues for the entire duration that a sample is aged.

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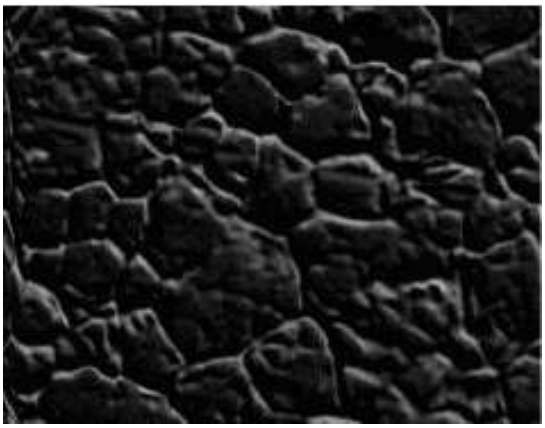

Fig. 1: SEM image of SS with lower Mo (320-type)

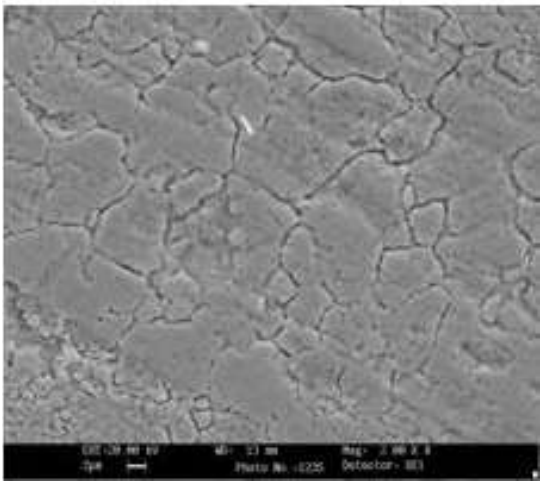

Fig. 2: SEM image of SS with higher Mo (340-type)

CONCLUSION

In the present work we have tried not only to characterize the lateral spreading of corrosion along a SS surface, but also to obtain the stability of SS for teaching to UHV condition down to 10^{-14} torr. We suggest adding Mo in UHV chamber generations to get suitable SS structure.

REFERENCES

1. www. Leemanlabs.com.
2. Jarman, R.T. and C.M. Turville, 1998. Condensation of Flue Gas Vapours in Ducts and Chimers, Atmospheric Environment, 17: 1837-48.
3. Kirby, R.E. and C. Pearson, 2001. Wet and dry hydrogen- fring of stainless steel, NLCTA, 68: 1-4.
4. Kadry, S., 2008. Corrosion analysis of stainless steel. European J. Scientific Research, 22: 508-516.
5. Chen, X.H., J. Tu, L. LU and K. Lu, 2005. Tensile properties of a nanocrystalline 316 L austenitic stainless steel. Scripta Materialia, 52: 1039-44.
6. Wang, J., E. Besnin, A. Duckham, S.J. Spey, M.E. Reiss, O.M. Knio and T.P. Weihs, 2004. Joining of stainless – steel specimens with nanostructured Al / Ni foils. J. Applied Physics, 95: 248-256.
7. Yu, M., A. Stryuchkova and E.V. Kasatkin, 2008. Nanostructure and Energy Properties of the Stainless steel X 18 N 10 T Surface Studied by Scanning Tunneling Microscopy and Scanning Tunneling Spectroscopy. Protection of Metals, 44: 582-588.
8. Liu, G., 2009. Low carbon steel with nanostructured surface layer induced by high-energy shot peening. Scripta Materialia, 44: 1791-1795.
9. Besnoin, E., S. Cerutti, O.M. Knio and T.P. Weihs, 2008. Exothermic reaction waves in multilayer nanofilms. J. Applied Physics, 92: 54-74.
10. Vadudt, J., K. Bitter, K. Neumann and A.M. Kielbassa, 2009. Ex vivo study on root canal instrumentation of two rotary nickel-titanium systems in comparison to stainless steel hand instruments. International Endodontic J., 42: 22-33.
11. Heilmann, P., J. Don, T.C. Sun, D.A. Rigney and W.A. Glaeser, 1983. Sliding wear and transfer. Wear, 91: 171-190.
12. Bahari, A., P. Morgen and Z.S. Li, 2006. Valence Bend Studies of the Formation Ultra thin Pure Silicon Nitride Films on Si(100). Surface Sci., 600: 2966-71.
13. Zhang, J. and A.T. Alpas, 2007. Transition between mild and severe wear in aluminium alloys. Acta Materialia, 45: 513-528.
14. Bahari, A., P. Morgen and Z.S. Li, 2008. Ultra thin silicon nitride films on Si (100) studied with core level photoemission. Surface Sci., 602: 2315-24.
15. Mindivan, H., H. Cimenoglu and E. Kayali, 2003. Microstructure and wear properties of brass synchroniser rings. Wear, 254: 532-537.
16. Bahari , A., 2008. The Effect of the Fractal clusters on the Si (111) - 7×7. Surface. World Applied Sciences J., 4: 261-265.
17. Morgen, P., A. Bahari and K. Pederson, 2006. Functional properties of Nanostructured Material. Springer, 223: 229-257.
18. Bahari, A., P. Morgen, Z.S. Li and K. Pederson, 2006. Growth of a Stacked Silicon Nitride /Silicon Oxide Dielectric on Si(100). J. Vacuum Science and Technology B, 24: 2119-23.