Effect of substratum temperature on morphology thin films stainless steel 304 by sputtering technique

C. López, H. Esparza and C. Carreño

Important advances have been made in the past few years in understanding the process of magnetron sputtering is one of the processes of physical vapor deposition (PVD) more important for growth of the thin films under vacuum conditions [1]. Recent research applies this technique to deposit nanostructured thin films, improving corrosion resistance on the surface of the substrate, it has been found that the thin films with grain size refinement, surface hardens, the substrate temperature has a direct relationship with the microstructure formed improved the mechanical properties [2].

The deposit for magnetron sputtering allows you to deposit a more uniform and stable coating free of dislocations, crystallography imperfections than other conventional methods [3]. Recently this technique has been applied to austenitic stainless steels which are very important in engineering since they possess a great chemical stability, in applications where a combination of high resistance is needed against corrosion, conformability and soldering. In this research work, the aim is grow thin films of stainless steel 304 on a substratum of the same steel, used magnetron sputtering technique employed three different deposition temperature (25, 100 and 200°C).

The nanostructured thin films were prepared by magnetron sputtering, in a system of cathode erosion INTERCOVAMEX V3 with a source of direct pulsated current. The goal of this technique is to transport material from the target to a substrate via shooting ions towards the target by means of the argon gas, being accelerated by the high voltage. The blank, obtained from the eroded atoms and the used substratum, came from the AISI 304. The dimensions of the target are 3 inch of diameter per

0.06 inch of thickness, whilst the dimensions used for each specimen are 0.98X0.79X0.06 in . The substrates were previously prepared before the deposit was refined superficially up to sandpaper

#1000 of SiC and, subsequently, being cleaned by acetone in the ultrasound. The parameters for the deposit appear in table 1, where the experimental variable of interest was the temperature of deposit at three different temperatures 25, 100 and 200°C (three specimens were made for each temperature of deposit). For one thin film was characterized for scanning electron microscope (SEM) and transmission electron microscope (TEM), to observe the morphology and microstructure.

Figure 1 shows the nanostructured thin films at different temperatures. It shows very clearly that the deposition temperature definitely influences the morphology of this nanostructured thin film at 25 ° C where a surface is covered with hemispheres and the presence of some cracks. At temperature of 100°C, there is a radically different morphology showing a surface covered with a series of tetrahedral circumstances. At 200°C, the same tetrahedral structure was present but more defined. The figure 2 shows three images where the average thickness was about 200 nm.

The roughness plays an important role to obtain a good or bad adhesion of the thin films, it is necessary a homogeneous surface. Deposition temperature is critical in the morphology of the nanostructure thin films and the showing a homogeneous growth on the surface of the substrate at 100 °C.

TABLE 1. Parameters of nanostructured films the AISI 304

Parameters	**Specimens**		
	1	**2**	**3**
Deposition temperature (°C)	25	100	200
Ar flow (sccm)	20		
Deposition time (min)	30		
Substrate	AISI 304		

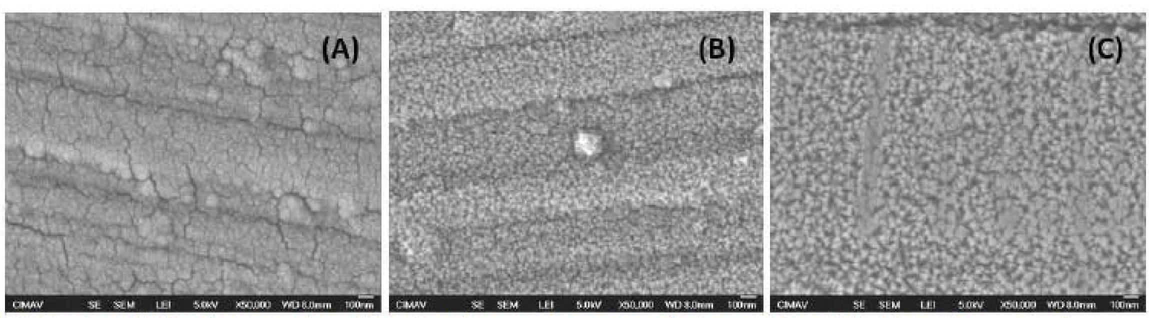

FIG. 1. SEM micrographs showing the surface morphology if the thin films deposited temperatures: (A) 25 °C, (B) 100°C and (C) 200°C.

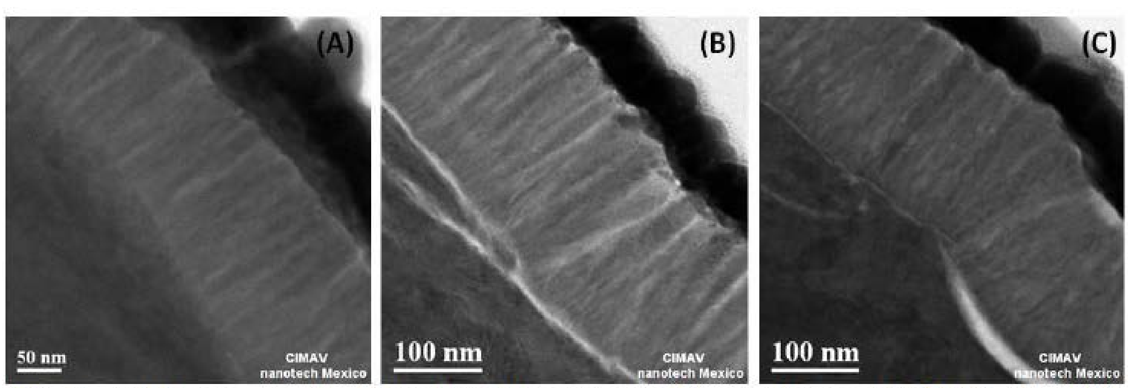

FIG. 2. TEM cross-section of the thin films deposited temperatures: (A) 25 °C, (B) 100°C and (C) 200°C.

References

[1] B. Window, *Surface and Coatings Technology*, 71 (1995) 93-97.

Microsc. Microanal. 18 (Suppl 2), 2012 1691

[2] G. Terwagne, J. Colaux, D. R. Mitchell, K. T. Short, *Thin Solid Films*, 469-470 (2004) 167- 172.

[3] Konstantinas Leinartas, Meilute Samuleviciene, Audrius Bagdonas, Remigijus Juskenas and Eimutis Juzeliuna, *Surface and Coatings Technology*, 168 (2003) 70-77.

[4] The research was supported by Redes Temáticas de Nanociencias y Nanotecnología CONACYT (160756).