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AFM and XPS analyses of magnetron sputtered TiN functional films on AISI M2 and AISI D6 steel substrates

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Abstract – The current technological applications of materials, mainly metals covered with nitride films are vast. However, now a lot of investigations exist with the objective of more and more to optimize the adherence of these films in steels substrate seeking to enlarge its application fields. The nitride films based on metallic cations, as titanium, zirconium, chrome and aluminum, have demonstrated to be interesting in applications where are necessary high surface hardness, corrosion and fracture resistance. However, the adherence of these films has been the main limitation for the tribological applications that demand high mechanic resistance. In this work it was proposed the study of techniques of interface dilution of film/substrate: i) diffusion or interdifusion provoked by temperature and ii) gradual variation of the chemical composition of the interface film-substrate (functional films). In this work, the TiN functional films depositions on AISI M2 and AISI D6 were accomplished. These functional films were obtained through magnetron sputtering. The main objective was creating diluted interfaces that they are areas where the properties of the film and substrate vary in a gradual way. These interfaces formed areas of tensions absorption generated by the functional film deposited. The morphology surface and chemical compounds of the films were characterized by atomic force microscopy (AFM) and X ray photoelectron spectroscopy (XPS). These results showed a good deposition with nanometre and homogeneous nucleus of the nitride titanium functional film deposited in AISI M2 and AISI D6 steels substrate.

The growth of ceramics on metal substrates has attracted attention for high technology devices [1-5]. Ceramics films on steels are particularly necessary for increasing their corrosion resistant and working life. The nitride films based on metallic cations, as titanium, zirconium, chrome and aluminum, have demonstrated to be interesting in applications where are necessary high surface hardness, corrosion and fracture resistance. Among these ceramic material, titanium nitride has been widely used as a protective coating material due to its excellent wear resistance, corrosion resistance, chemical stability, and diffusion barrier properties. Due to these unique properties, TiN is an important material in the advanced metallization area for ultra large scale integrated circuits and in advanced surface protective film area for steel [1,2,4-7]. Moreover, titanium nitride thin film has been widely employed in cutting tools to extend their working life and in decorations for its golden color. However, the adherence of these films has been the main limitation for the tribological applications that demand high mechanic resistance. Nowadays, now a lot of investigations exist with the objective of more and more to optimize the adherence of these films in steels substrate seeking to enlarge its application fields [8-11].

The purpose of this research work is to investigate the gradual variation of the chemical composition of TiN film/AISI M2 substrate and TiN film/AISI D6 substrate interfaces by using a magnetron sputtering. The adherence of titanium films on steel substrate has been demonstrating good adherence results [12].

[1] M. H. Staia, B. Lewis, J. Cawley, T. Hudson. Surf. Coat. Technol. 76-77 (1995), p.231-236.
[2] Z. Iqbal, A. Rauf, A. Ali, A. ul Haq, A. Q. Khan. Vacuum 51 (1998), p.629-633.
[3] F. Lu, H. Chen. Surf. Coat. Technol. 130 (2000), p.290-296.
[4] T. W. Kang, T. W. Kim. Applied Surface Science 150 (1999), p.190-194.
[5] A. Schulz, H. R. Stock, P. Mayr, J. Staeves, D. Schmoeckel. Surf. Coat. Technol. 94-95 (1997), p.446-450.
[6] Y. Y. Guu, J. F. Lin, C. Ai. Thin Solid Films 302 (1997), p.193-200.
[7] P. V. Kola, S. Daniels, D. C. Cameron, M. S. J. Hashmi. Journal of Materials Processing Technology 56 (1996), p.422-430.
[8] K. Bartsch, A. Leonhardt, U. Langer, K. Künanz. Surf. Coat. Technol. 94-95 (1997), p.168-173.
[9] R. Morita, K. Azuma, S. Inoue, R. Miyano, H. Takikawa, A. Kobayashi, E. Fujiwara, H. Uchida, M. Yatsuzuka. Surf. Coat. Technol. 136 (2001), p.207-210.
[10] R. A. Vieira, M. C. A. Nono. Materials Science Forum 498 (2005), p.717-721.
[11] R. A. Vieira, M. C. A. Nono. Journal of metastable and nanocrystalline materials 20-21 (2004), p.654-658.
[12] R. A. Vieira, M. C. A. Nono, N. C. Cruz. Phys. Stat. Sol. (b) 232 (2002), p. 116-120.