CHROMIUM AND ZIRCONIUM TYPE LAYERS PRODUCED FROM METALORGANIC COMPOUNDS USING THE GLOW DISCHARGE CONDITIONS

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The present study presents the results of experiments on the production of CrN by the PAMOCVD method with the use of chromium acetylacetonate - $(CH_3COCH_2O)_3Cr$. Hydrogen and nitrogen were passed through the reaction chamber at a rate of 10 dm^3/h each. The pressure in the chamber was 4 hPa. Another experiment was devoted to the obtaining of zirconium containing layers form zirconium tert-butoxide. The gaseous atmosphere was composed of nitrogen and hydrogen in the 1:1 proportion, and the process temperature ranged from 600 to 800°C. The flow rate of the metallorganic zirconium compound was $2cm^3/h$. The process duration was 3h. The layers were produced on Armco iron. The process with the participation of the solution of chromium acetylacetonate in acetic acid carried out at temperatures of 600 and 700°C only results in the Armco iron samples being carbonised. This can be attributed to the fact that the solvent contained 40% of carbon. In the next trials, the vapours of this compound were mixed with nitrogen and hydrogen and then delivered to the reaction chamber The CrN phase appears, together with the Fe_4N phase - which means that the nitriding process continues to proceed, when the temperature is increased to 600°C. The further increase in the process temperature to 700°C increases the amount of the CrN phase formed in the layer. (increased microhardness). Fig. 1shows the results of EDS examinations of the chemical composition of the layer surface in the samples treated at 700°C. Fig.2. shows the boundary between the zones, exposed and not exposed to the action of corrosive surroundings, in the layer formed at 700°C (that showing the best corrosion resistance). The SEM photograph shows a well marked difference in topography between the surfaces exposed and non-exposed to corrosive surroundings. Although the surface layer seems to be smooth, it appears that it possesses cracks and is contaminated with carbon and oxygen. The layers containing zirconium were also produced on Armco iron. When the zirconium tert-butoxide was applied at a temperature of 600°C, the only process that occurs is nitriding. The increase of the temperature to 700°C resulted in a ZrO_2 layer being formed. Above 750°C, the surface was covered with soot and carbonisation process took place. Fig.3 shows microphotographs of the surface layers produced at temperature of 700°C. We must add that the surface treatment applied improved the corrosion resistance of Armco iron only slightly. The best corrosion resistance is shown by the layer produced at a temperature of 700°C. The reason why the treatment improves the corrosion resistance of the surface layers only slightly may be that their structure is not sufficiently compact and homogeneous. It however appeared that these surface layers substantially increased the frictional wear resistance (Fig. 4). Armco iron undergoes seizure as early as after 20 min of the test, whereas the linear wear of the ZrO_2 layer produced at 700°C is 3μm.

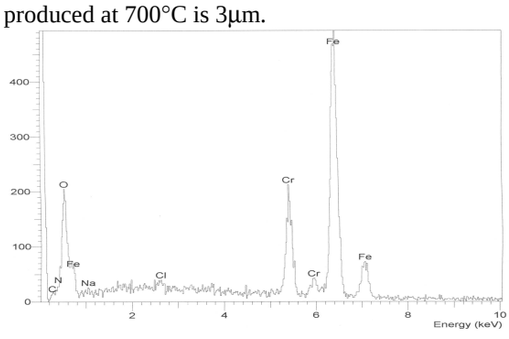

Fig.1. Chemical composition of the layers formed at a temperature of 700°C (EDS results).

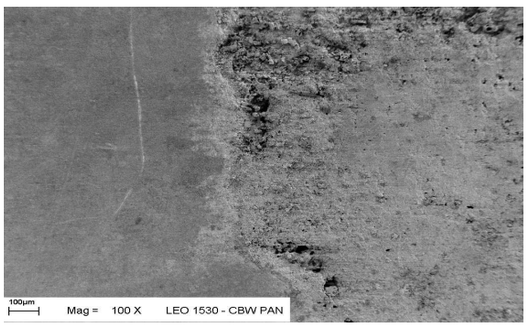

Fig.2. The boundary between the exposed and non-exposed portions of the surface in a layer produced at a temperature of 700°C.

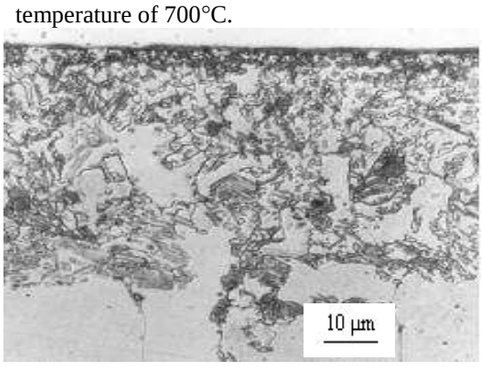

Fig.3. Microphotograph of the layer produced at temperature of 700°C.

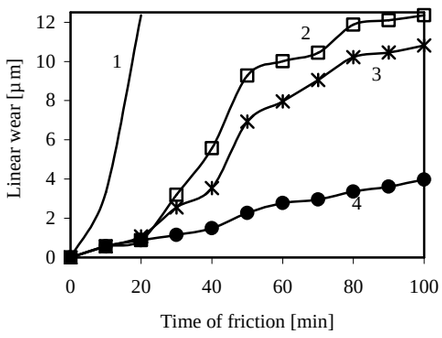

Fig.4. Linear wear of the ZrO_2 layers produced at various temperatures: 650°C (2), 750°C (3) and 700°C (4), measured as a function of the friction time under a unit load of 100MPa; curve (1) - untreated substrate.