Successful cases of technological transfer from IK4 Research Alliance

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Abstract

IK4 Research Alliance comprises nine technological centers and is one of the major points of reference. Our main objective is to bring resources together and to exchange best practice in order to help our technological centers reach greater levels of technological-scientific excellence within the Basque System of Innovation. The following technology centers form part of IK4: AZTERLAN, CEIT, GAIKER, IKERLAN, LORTEK, TEKNIKER, CIDETEC, IDEKO and VICOMTECH. As a result of our work, some results lead to the generation of patents, new products or spin-off companies. Two successful cases will be explained.

1/ The improvement in fatigue and wear resistance under high pressures in mechanical components is currently more and more taken into account as possible way of diminishing their component weight in association with a cost diminution. This is very important in industrial sectors under pressure like the automotive industry.

Traditionally DLC (Diamond like Carbon) layers have been studied and proposed for these tribological applications. These DLC thin layers have already shown some weak points for high temperature applications since the DLC layers tend to graphitize above 180ºC producing the failure of the tribo-systems. Thus, an alternative Zr(C,N) coating has been developed by IK4-TEKNIKER. Cathodic arc evaporation was used to deposit this 2.5 micron coating on a nitrogen alloyed steel substrate (Cronidur 30). The carbon content of the coating (acetylene gas in the chamber) was a parameter of great importance in the tribological performance of the system. The interface should also remain clean in the first phase of the deposition and the process-related interlayer (here made in Zr) must be very thin to reduce the risk of contamination or defect presences (see Figure 1).

The coating is crystalline with a cubic structure. The evaluated average grain size is situated between 7 to 10 nm. A benchmarking carried out by the BMW [1], regarding the load carrying capacity and lifetime under lubricated rolling and slip-rolling motion of these novel coatings, has revealed that these layers resist mean Hertzian pressures of P_0max >2.94 GPa under mixing/boundary friction conditions at oil temperature of over 100ºC and up to ten millions cycles. These results confirm that the developed Zr(C, N) coating outperformed the latest developments in DLC coatings under these working conditions, opening a new field of applications for zirconium based coatings.

2/ Graphene is formed by a crystalline hexagonal net of carbon atoms, forming a layer with a thickness of one only atom. Thus, it is a bidimensional material. This particular structure leads this material to present exceptional properties and a wide range of potential applications: electronics, batteries, touch-screens, automotive body parts, etc.

In this work, graphene oxide GRAnPH® is obtained from carbon nanofibers (GANF®) synthesized by the company Grupo Antolín using chemical methods.

Samples have been analyzed by transmission electron microscopy (TEM). The equipment is a Tecnai G2 S-TWIN (FEI company). Samples were previously prepared at Grupo Antolín laboratories and analyzed at GAIKER-IK4 by HRTEM with 200 kV of voltage.

From the images obtained by TEM we can see graphene films which thicknesses are likely to be bellow 1 nm. Besides, this tool allow us to see the layered structure, dimensions in XY directions and flexibility (see Figure 2, right). Finally, we can also know the efficiency of the method used to obtain graphene oxide. We have to observe the existence or absence of original carbon nanofibers and as a result we can adjust the process parameters.

References

[1] Charles-Alix Manier, Holger Ziegele, Javier Barriga, Josu Goikoetxea, Mathias Woydt, Zirconium-based coatings in highly stressed rolling contacts as alternative solution to DLC and ta-C coatings, Wear 269 (2010) 770–781.

Figures

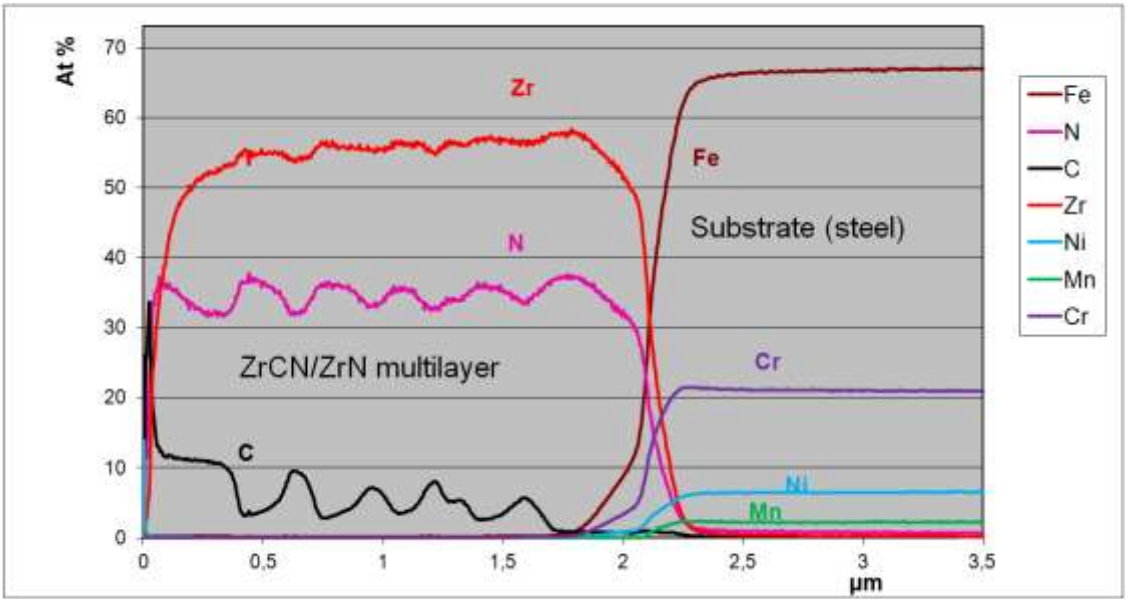

Figure 1: GDOES profile showing the composition of Zr(C, N) coating

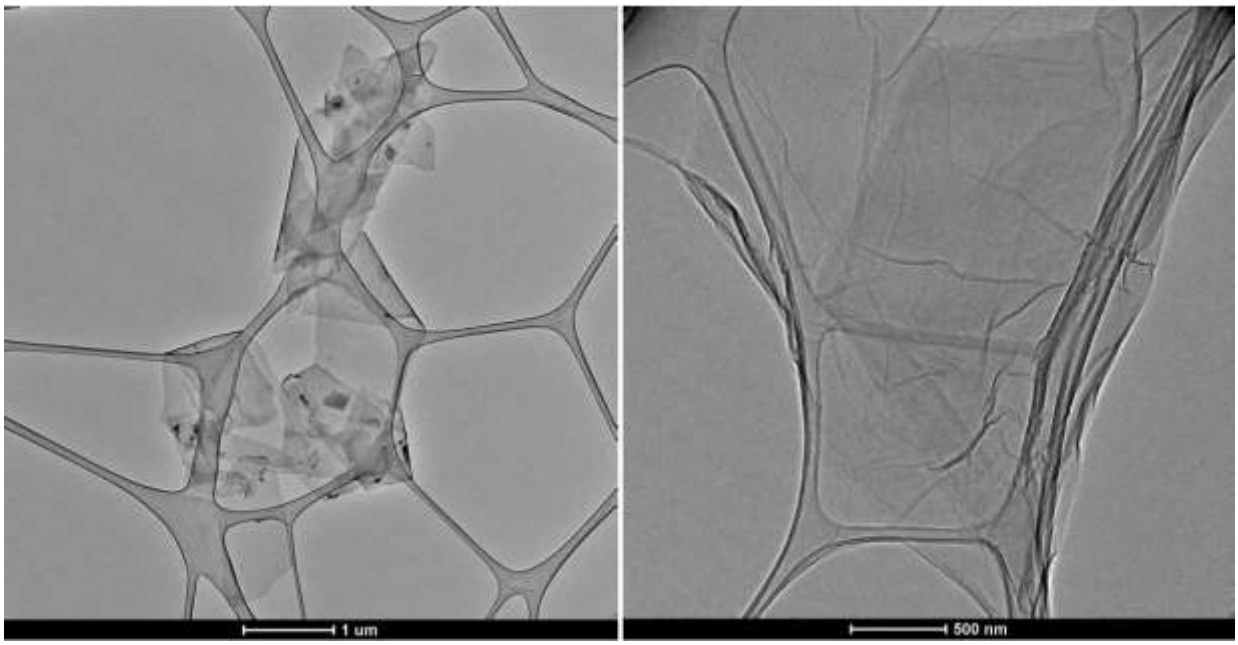

Figure 2: TEM images of oxide GRAnPH® with and without carbon nanofibers GANF®