



Coating for future reference

TECHNOLOGY

In our report of Engine Expo 2018 (*RET* 113, September/October 2018) we noted that Oerlikon Balzers was heralding the imminent arrival of an important new DLC coating. Segment manager motorsports for Oerlikon Balzers, Marc Herve, gave what he called a ‘teaser presentation’ at the event. He told us, “For valvetrain applications, for the past couple of decades the Sorevi-developed CAVIDUR has been the reference coating – our ambition is for our new coating to be the reference for valvetrains for the next 20 years.”

Sorevi’s DLC business was absorbed by Oerlikon Balzers some years ago, and Herve (who worked for Sorevi) said the brand new coating has required the development of new coating machines. “It is a new formula and uses new coating technology,” he revealed. This new coating has now been released by Oerlikon Balzers under the name BALIQ CARBOS.

Herve explained that regular DLC coatings are produced through plasma-assisted chemical vapour deposition (PACVD), which produces extremely hard yet thin low-friction coatings that provide high adhesion to substrates. Most such coatings are made of amorphous carbon with hydrogen (a-C:H).

“Although today’s a-C:H coatings can be produced at high volume for low prices, in terms of their design properties they are reaching their performance limits,” Herve said. “When a customer seeks higher performance than an a-C:H coating can deliver, the only option to date has been a hydrogen-free DLC, which is more expensive to produce.”

Hydrogen-free coatings are made using physical vapour deposition (PVD), using an arc method that produces tetrahedral amorphous carbon (ta-C). While this can create a very dense, very hard thin coating with high adhesion, the process produces small droplets that

result in a rough surface finish. Owing to the coating’s hardness the necessary secondary polishing process, which requires specialised machinery, is time-consuming and expensive.

The BALIQ CARBOS coating is applied using Scalable Pulsed Power Plasma (S3p), a proprietary process developed by Oerlikon Balzers. This, said Herve, combines the advantages of the arc evaporation and (PACVD) sputtering methods.

Arc evaporation is known for producing dense coatings with high adhesion. Sputtering, a conventional coating technology where atoms are ejected from a target or source material to be deposited on a substrate, is renowned for high levels of smoothness.

The upshot is that BALIQ CARBOS is a hydrogen-free DLC that delivers a combination of high hardness, low friction and a from-the-machine smooth surface. Herve said, “It has adhesion and hardness comparable to a ta-C coating with the same low roughness of Ra = 0.03 µm as PACVD coatings. It is so smooth from the machine and doesn’t require the intensive post-polish of a ta-C – in most cases, the component is ready to use immediately after coating.”

The S3p technology generates a high level of ‘diamond’ (tetrahedral) bonds with a hardness of up to 40 GPa (indentation hardness, HIT). In comparison, said Herve, typical DLC coatings achieve hardness levels in the 20-30 GPa range. He added that BALIQ CARBOS exhibits an abrasive wear that is three times lower than a 20 GPa hard DLC coating as measured by a calo test (ball cratering with abrasive slurry).

The new coating process operates at a relatively low temperature, below 200 C, compared to up to 350 C for other DLC coatings, which enables its application to a much wider panel of materials, effectively bonding to aluminium and steel substrates. That opens up more options for coating applications.