A DOSE OF "THE HARD STUFF" IS JUST WHAT YOU NEED

Today's smart devices offer us more capability than ever, but we expect them to be more robust than ever too. Evatec's **Dr. Maria Fischer** tells us about the new hard coating solutions available to protect them as they taking a pounding in our pockets or lying in the sand.

Electronic gadgets such as smartphones, watches, tablets and e-readers have become our every-day companions. We carry them in our pockets along with keys, coins and other objects, take them to the beach where they are exposed to sand and salt mist, and occasionally even drop them. All these situations mean exposure to extreme conditions of an abrasive, corrosive or impact nature. These costly electronic companions are valuable, and we want them to survive such incidents unharmed posing great challenges to materials engineering.

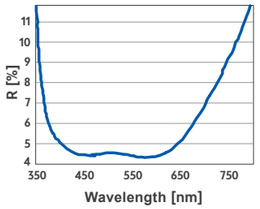
The cover glass dilema

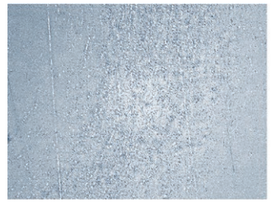
In particular, slim glass covers and screens of smart devices are prone to damage by abrasion or impact. Improving their resilience resembles a tightrope walk. Screens made from crystalline sapphire, for example, are hard and scratch-resistant, but easily shatter into pieces when dropping due to the rigid nature of a crystal. In contrast, screens made from hardened glass are less prone to fractures due to the flexibility of their amorphous structure, but scratch a lot more easily.

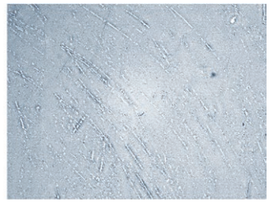
A solution to this dilemma is to start with a screen of flexible, hardened glass, and apply a tough protective coating on the user-facing side. In our LAYERS 3 magazine, we talked about DLC as a candidate for such a protective coating. While DLC provides excellent tribological resistance, it absorbs light in the visible, and must therefore remain ultra-thin if applied to objects that require optical transparency. This thinness of course limits its protective function.

Standard AR Coating from Nb_2O_5 & SiO_2

Material	Thickness [nm]
Nb_2O_5	11.1
SiO_2	25.0
Nb_2O_5	101.8
SiO_2	77.2

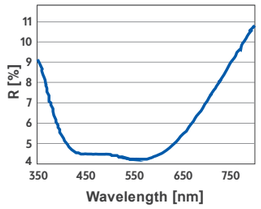


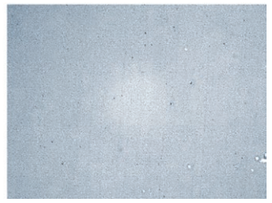




Evatec's TPC solution

Material	Thickness [nm]
TPC	18.1
SiO_2	17.1
TPC	91.7
SiO_2	78.3





Design | Optical reflection spectrum | Wiper test | Abrasive rubber test

Figure 1: AR coatings from the standard materials Nb_2O_5/SiO_2 (top) and Evatec's TPC/SiO_2 (bottom). Stack design, spectral performance and abrasion test images are shown. The wiper test was performed with a rubber wiper of 20mm length, spinning on SiO_2 beads immersed in water, with 60rpm for 8min. The abrasive rubber test was performed in 300 cycles with a rubber cylinder of 15 mm diameter, with 2kg load, rotating at 100rpm.

A new type of coating

As an alternative, a tough coating has been developed which is fully transparent to the human eye. This transparent protective coating (TPC) can be applied in thicknesses of micrometers, while still providing full transparency. This lends itself well for application in antireflective (AR) coatings. A tribological comparison between a standard AR coating made from Nb_2O_5 and SiO_2, and an AR coating using Evatec's TPC, is shown in figure 1. Abrasive scratch tests are shown, made with a rotating rubber wiper and stencil. The working principle of the wiper test is illustrated in figure 2. After the test, the TPC-AR coating contains less scratches and thus provides enhanced abrasion resistance in comparison to the standard AR, while the spectral performance is still maintained.

Designing our TPC required tuning of coating qualities such as hardness, elasticity, roughness and stress, since best performance is sought in terms of abrasion resistance, glass breaking strength and optical imperceptibility. Figure 3 shows a nanoscratch made with increasing load both on bare hardened glass and on Evatec's TPC, providing protection to the glass underneath.

While a standard process for the TPC coating is already in our portfolio, Evatec has now further enhanced the performance by tuning the coating architecture. Starting from a uniform single layer, properties gradients were implemented through gradually changing process parameters. This allowed us to match the coating to the glass at the interface, and to environmental impacts on the top.

Mass production solutions are ready

Evatec's TPC is currently available on the SOLARIS® S151 platform (Figure 4), which is ideal for high throughput processing of objects the typical size of mobile phones and tablets. The 6 process stations of SOLARIS® S151 can be equipped with capability for RTP, PVD, Etch or CVD. Direct substrate or carrier handling for mini batches without compromise in process quality provide flexibility for changes of process or substrate size. So, why not Contact Evatec's BU Photonics to find out more about SOLARIS® and how it's the perfect solution to deliver exactly the dose of the hard stuff you need for your smart device production.

The wiper test

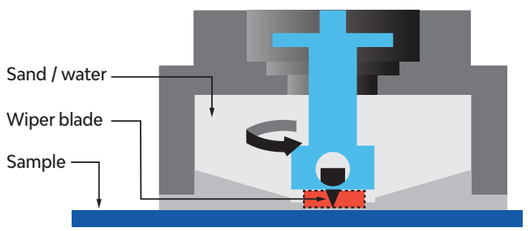


Figure 2: Schematic drawing of the "windshield wiper blade test", or "wiper test" in short. A container placed on the coated glass is filled with a mixture of sand and water, and a wiper blade rotates with defined force according to standards defined by the RSRE (Royal Signals and Radar Establishment).

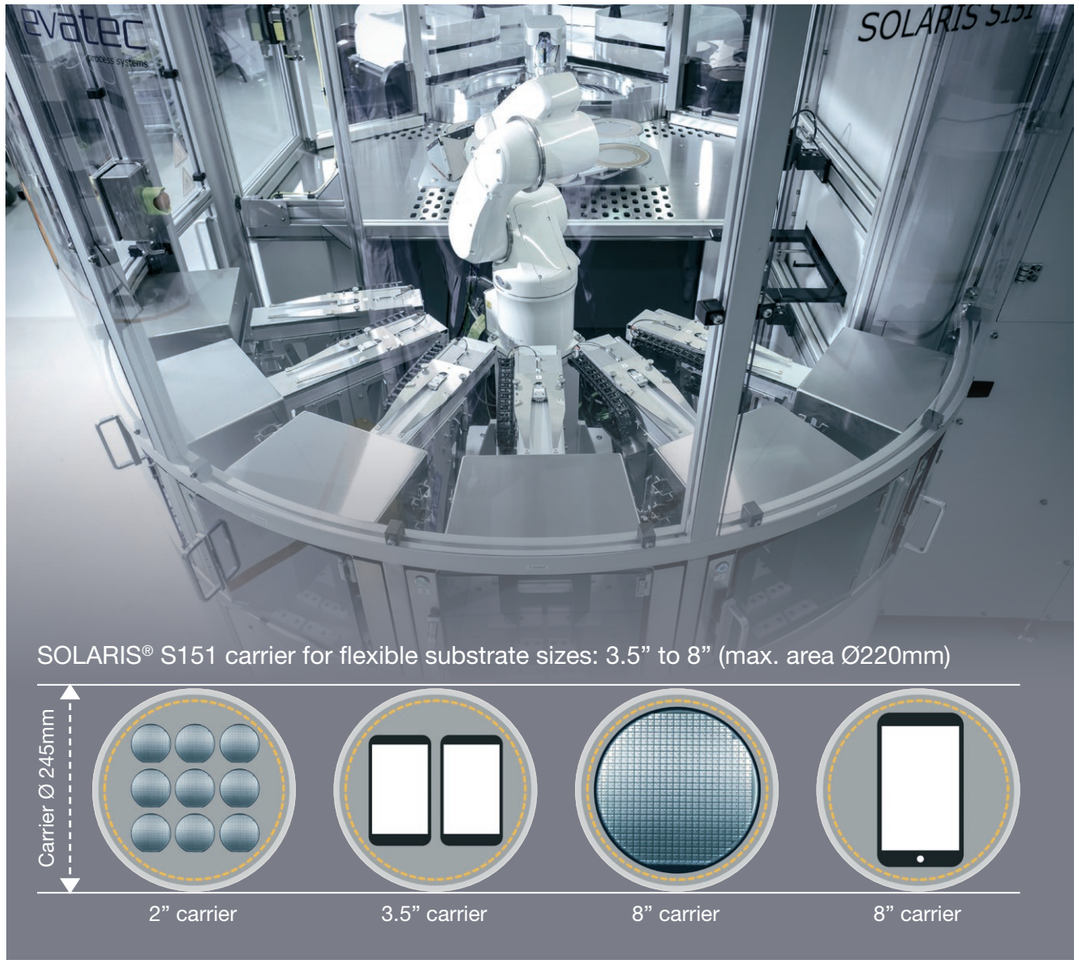


Figure 4: The fully automated flexible SOLARIS® platform can handle a wide range of substrate sizes easily.

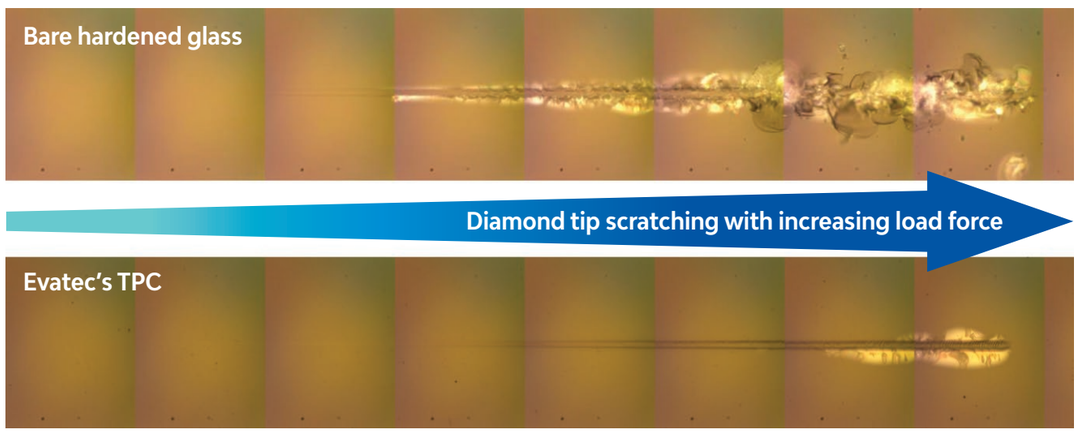


Figure 3: Nanoscratches made with a conical diamond tip and increasing load up to 300mN, on bare hardened glass (top) and on Evatec's TPC of 2µm thickness (bottom).