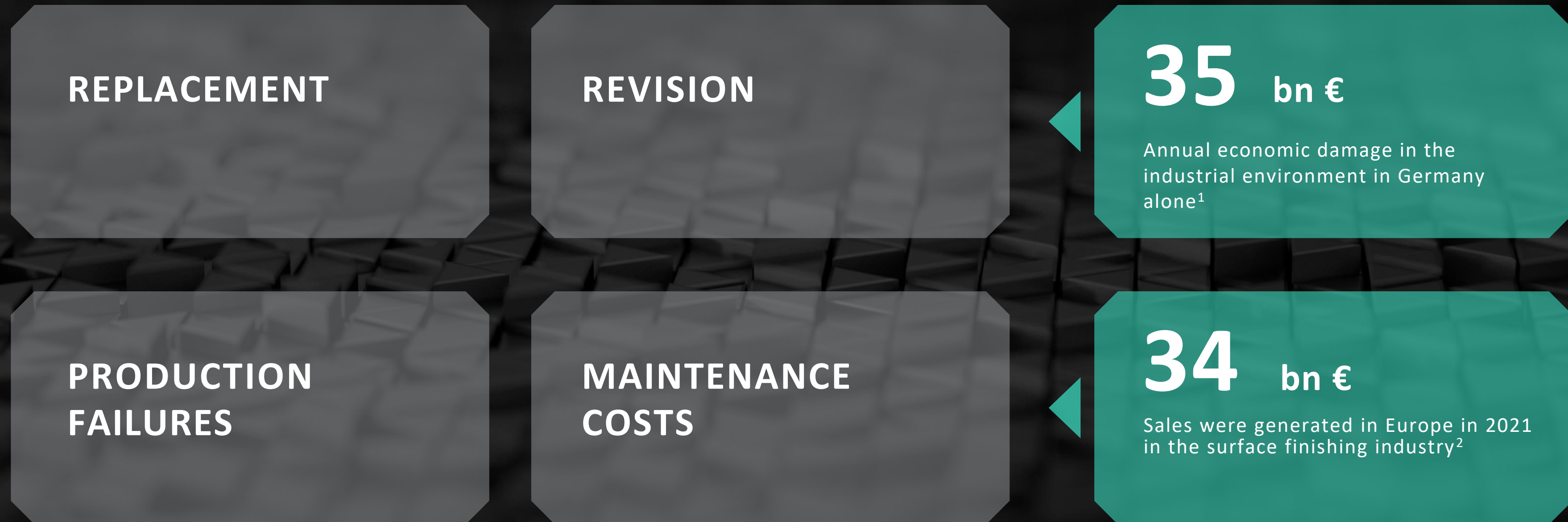




**Super-hard and stress-free DLC 2.0 Coatings
for Tools and Components in Manufacturing**

Wear of Tools and Components

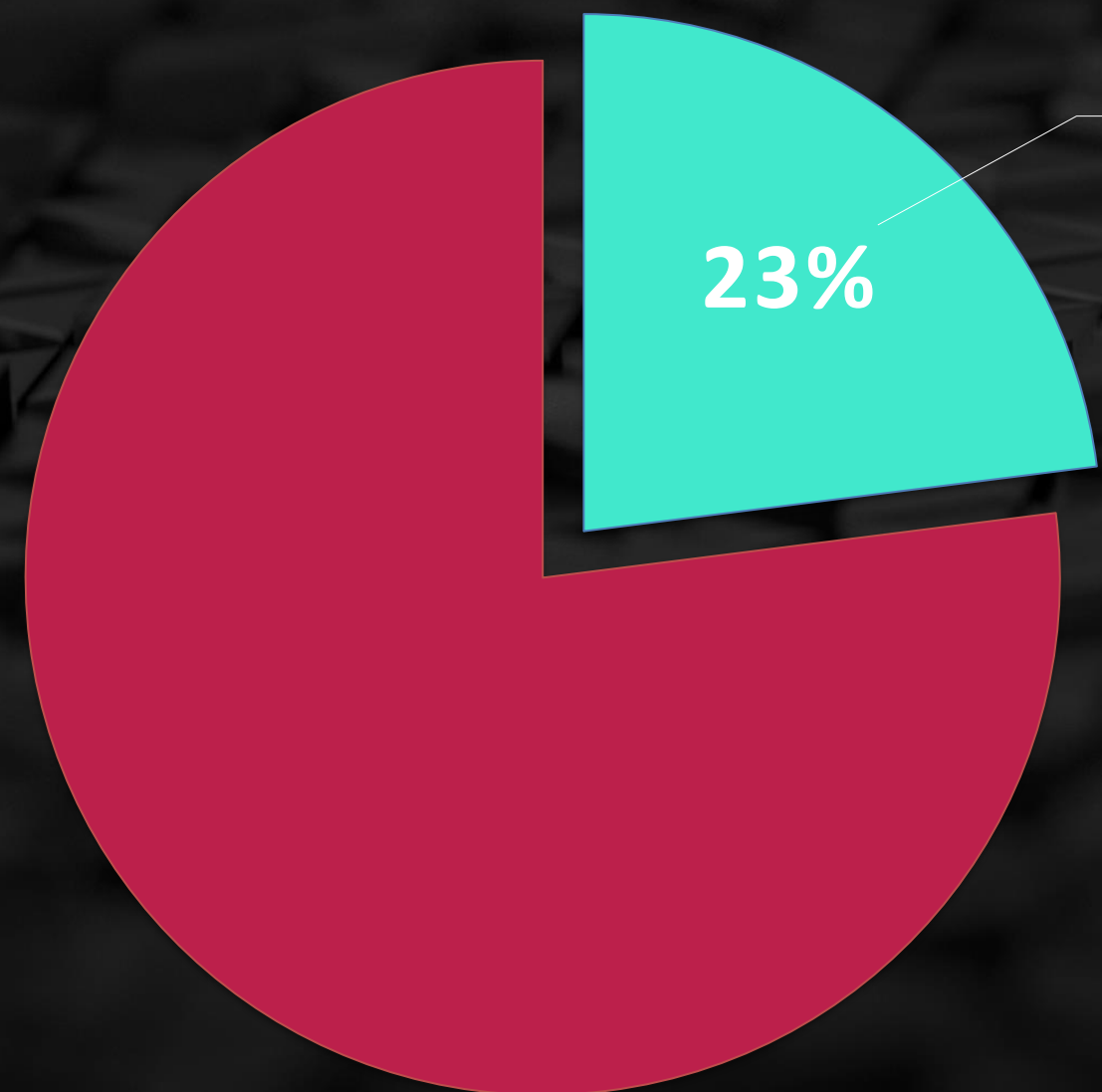


¹ Source: Prof. Dr. Martin Dienwiebel, Karlsruhe Institute of Technology/Institute for Applied Materials, 2018

² Source: Markets and Markets - Forecast, 2019

Energy Losses

World's total energy consumption:



Energy consumption caused by tribological contacts

Forecast: Energy savings potential through new technologies



-18% energy losses within next 8 years

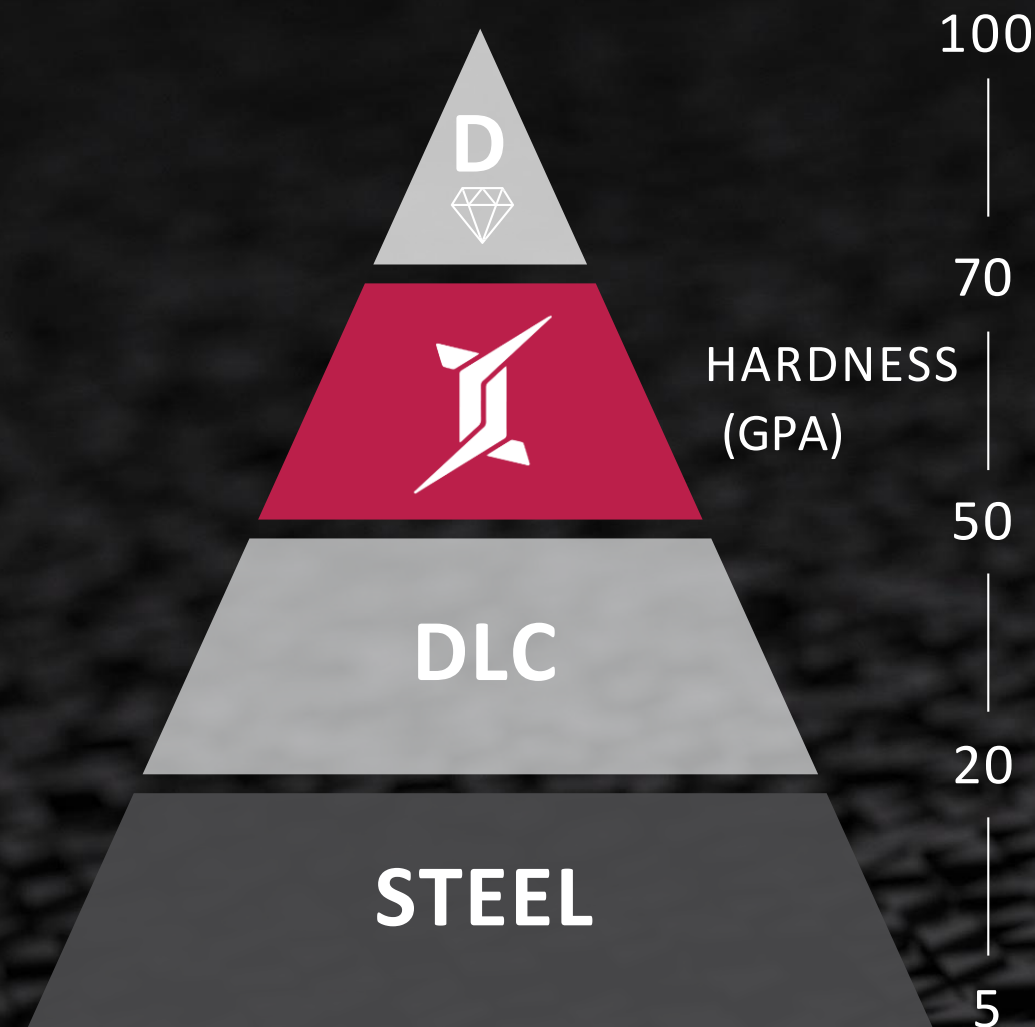


-40% energy losses within next 15 years

Source: study of Holmberg & Erdemir: Influence of tribology on global energy consumption, costs and emissions, 2017

Our Solution

NEW WEAR-PROTECTION COATINGS
made of diamond-like carbon (sTAC60®) with
outstanding properties



USP

- ▶ extreme hardness

no internal stress

- ▶ no limitation in film thickness
- ▶ high mechanical stability
- ▶ broadband application capability

CUSTOMER BENEFITS

- ▶ **new fields of application**
- ▶ **cost savings**
through tool life extension

UP TO FACTOR 20!

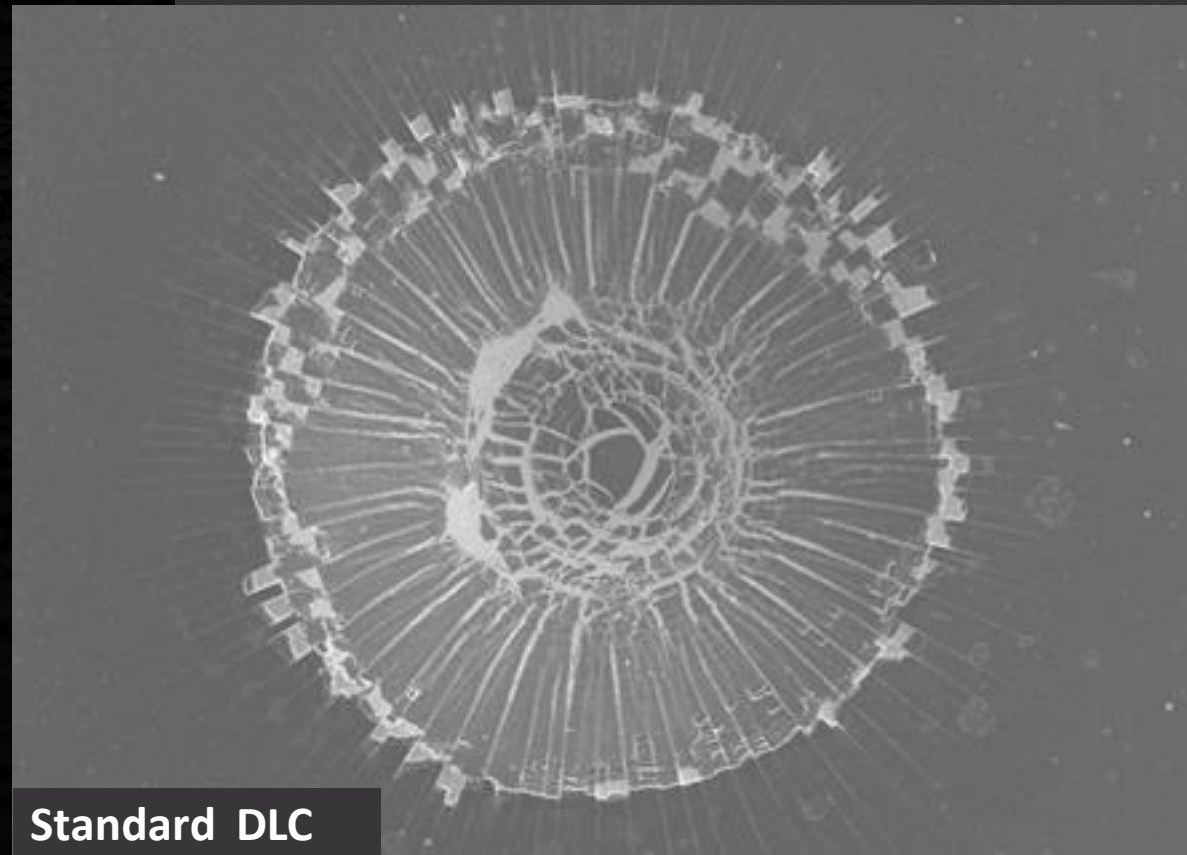
- ▶ enhanced process stability
- ▶ better machining quality
- ▶ more energy efficiency
- ▶ reduction / elimination of lubricants

How tough are our Coatings?

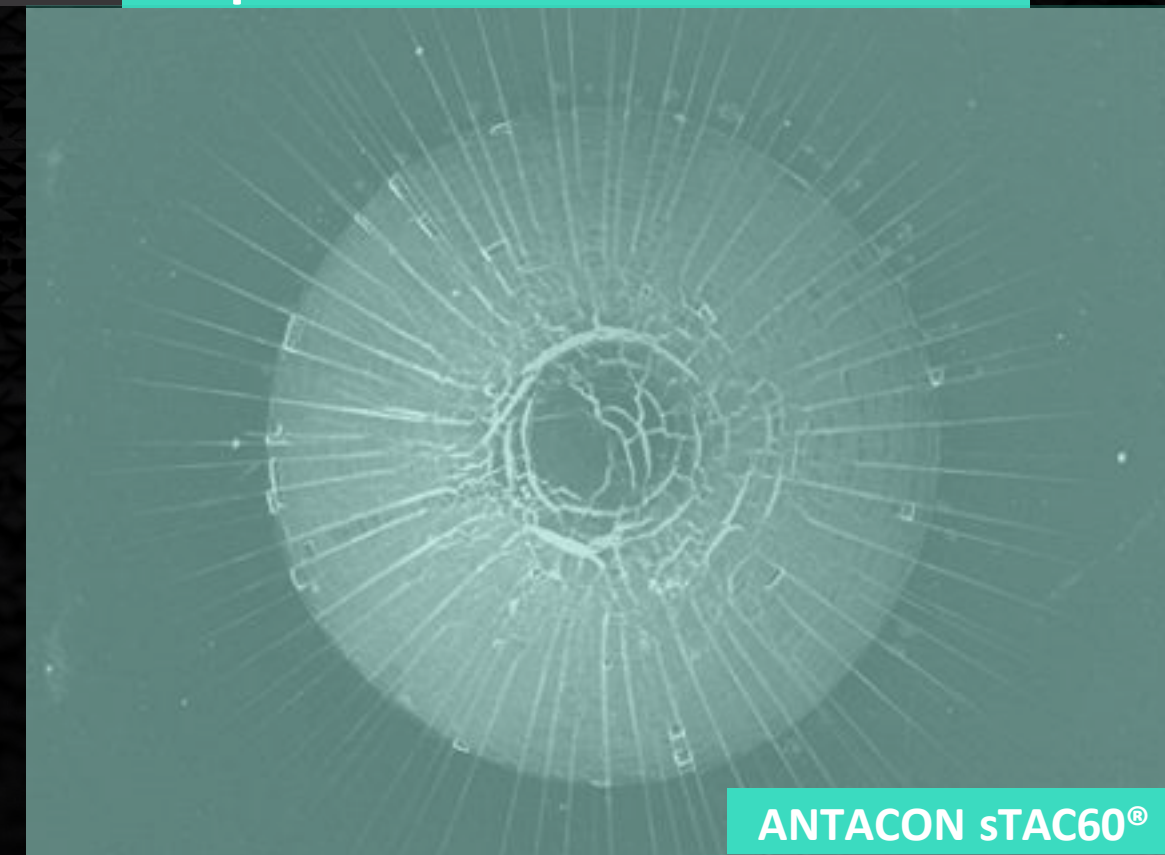
- ▶ mechanical stability and adhesion are significantly increased by the absence of residual stress!

Rockwell penetration test (DIN 4856):

1 μm DLC each on 100Cr6 steel



Standard layer with high residual stress, poor adhesion and stability (HF3/ HF4).



Stress-free ANTACON layer with excellent adhesion and mechanical stability (HF1).

ANTACON USP



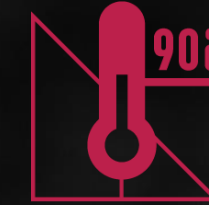
HARDNESS



STABILITY



FRICTION



TEMPERATURE



SURFACE

“Unsurpassed mechanical stability and hardness of anti-wear coatings with minimal friction.”



adhesion and very good mechanical stability of super-hard DLC coatings due to patented coating technology



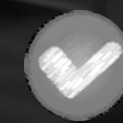
for the first time - no limitation of the layer thickness



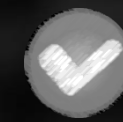
surfaces with $R_a \leq 0.02$ to $0.1 \mu\text{m}$ without post-treatment for tribological applications



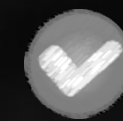
extreme hardness and wear resistance



with sTAC60[®], a tool deformation of up to 5 % is possible without delamination of the layer



no loss of hardness or deformation of temperature-sensitive materials ($T_{\text{Process}} < 90 \text{ °C}$)

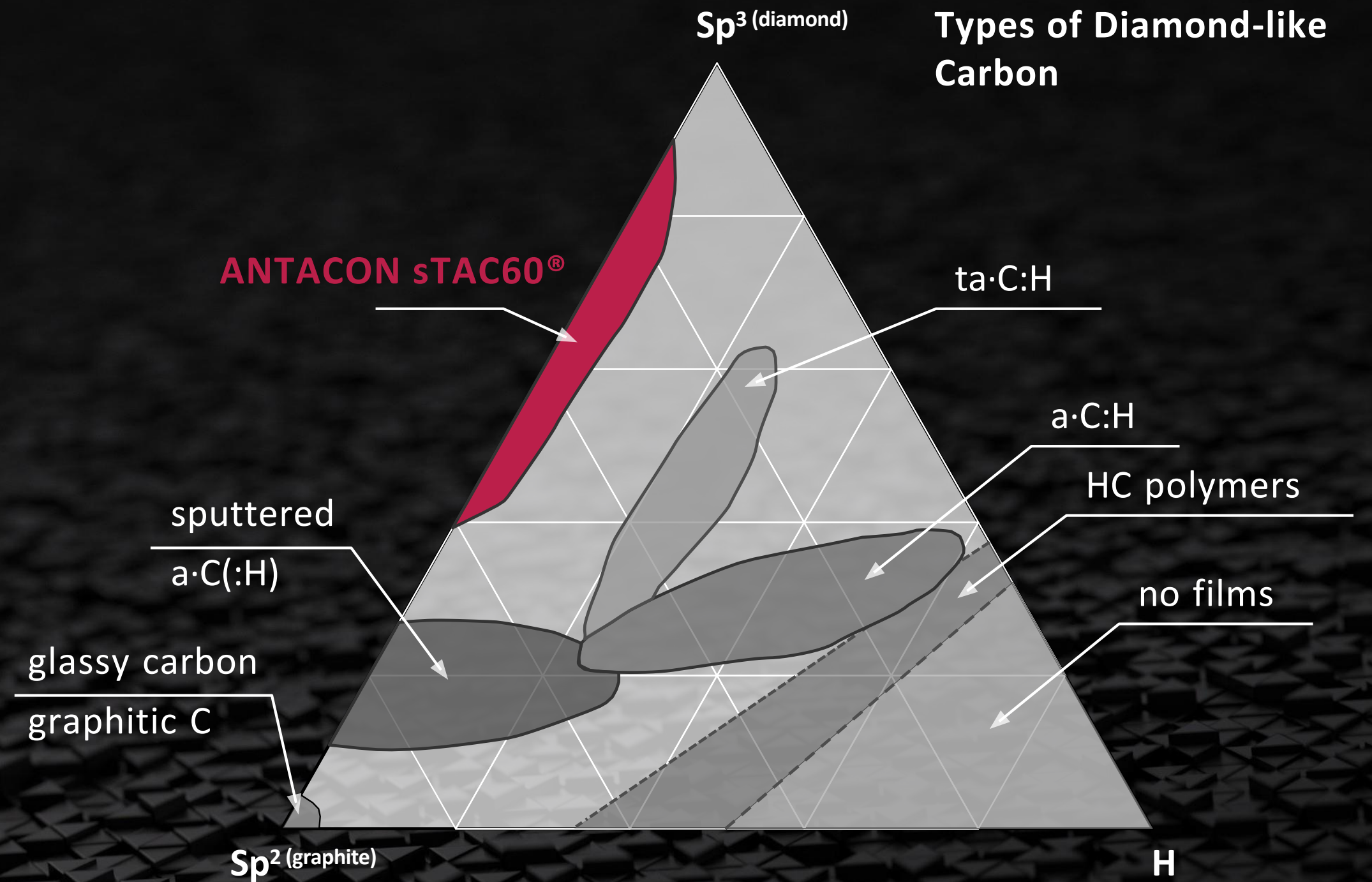


Design of application-related coatings with hardness and / or Young's modulus gradient coatings

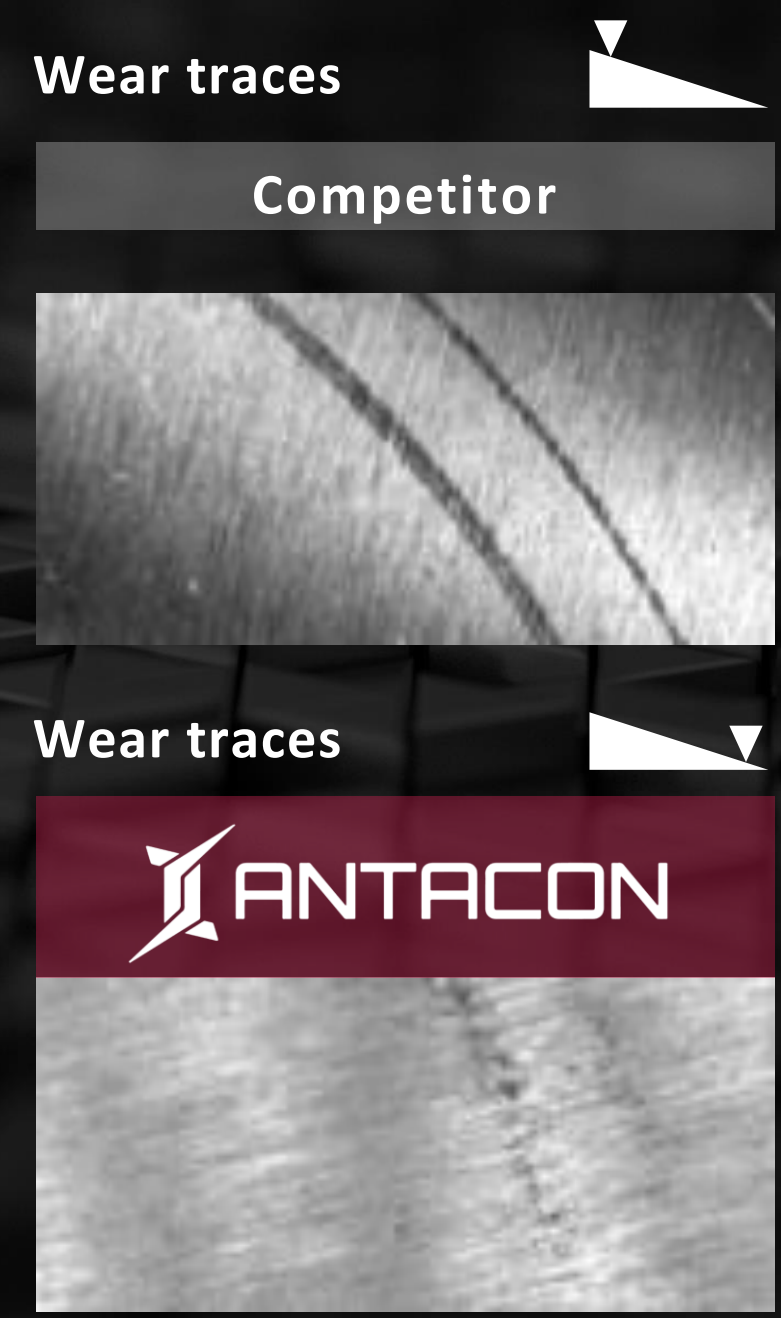
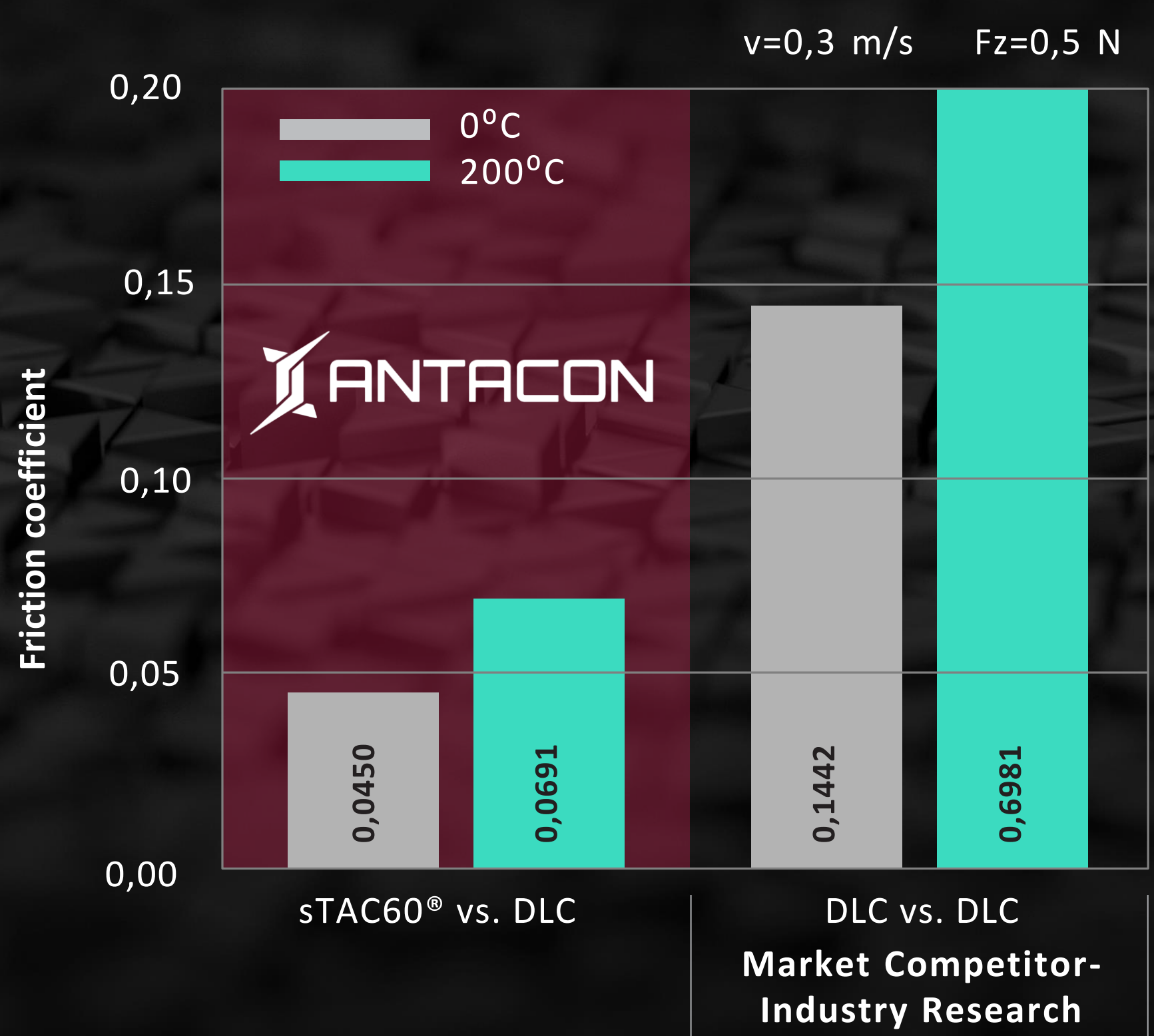
Diamond-like Carbon Characteristics

sTAC60[®] LAYER PROPERTIES

Material:	pure carbon
Structure:	amorphous
Nano hardness HIT [GPa]:	up to 70
Residual stress [GPa]:	less than 0.1
possible layer thickness [μm]:	no technical limitation



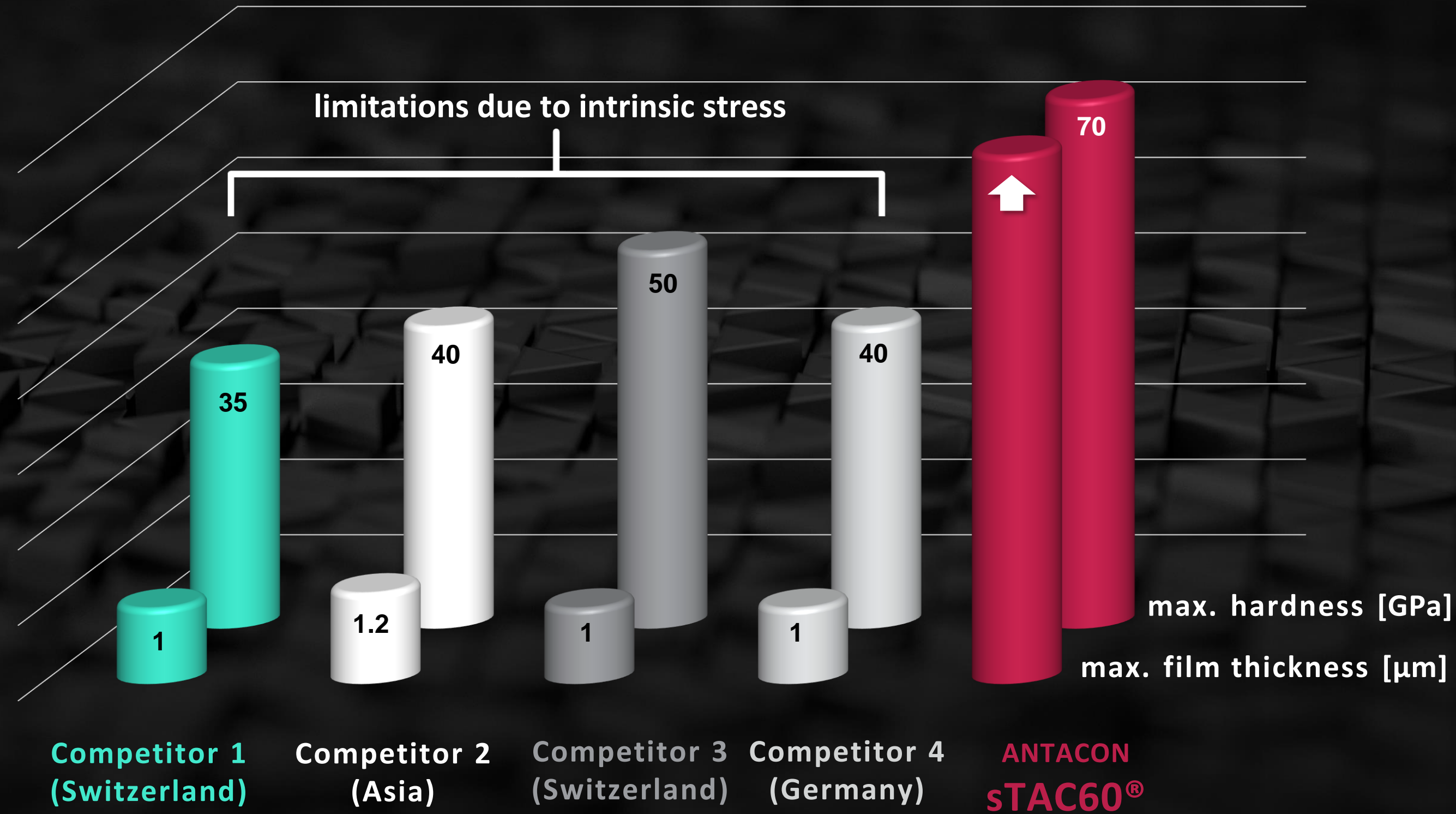
Friction Behavior ANTACON vs. Market Competitors



Advantages of the ANTACON sTAC60®





- ▶ 3 times lower friction than standard DLC at 0°C
- ▶ 10 times lower friction than standard DLC at 200°C
- ▶ almost no measurable wear

Market Comparison



sTAC60®
BREAKS ALL LIMITS

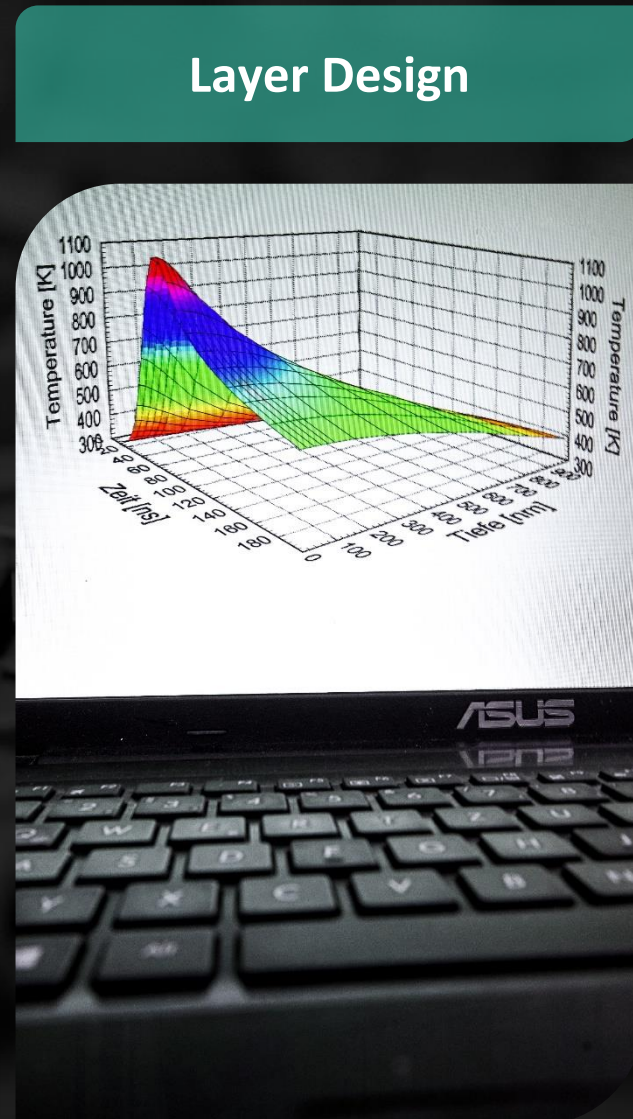
Products Overview

	 sTAC60[®]	 DLC40	 DLC25	 DLC Custom
Layer material	Pure Carbon			
Layer architecture	layer system			gradient- and multilayers
Hardness H_{IT} [GPa]	> 60	35 - 45	20 - 30	25 - 70
Residual stress [GPa]	0,1	4 - 5	ca. 1	12 - 0,1
Film thickness [μm]	no technical limitation	< 6	< 10	0,1 - 10
Coefficient of friction (dry vs. steel)	0,1			
Average roughness R_a [μm]	< 0,1			
max. operating temperature [°C]	< 500	300 - 400		< 500
Deposition temperature [°C]	< 90			

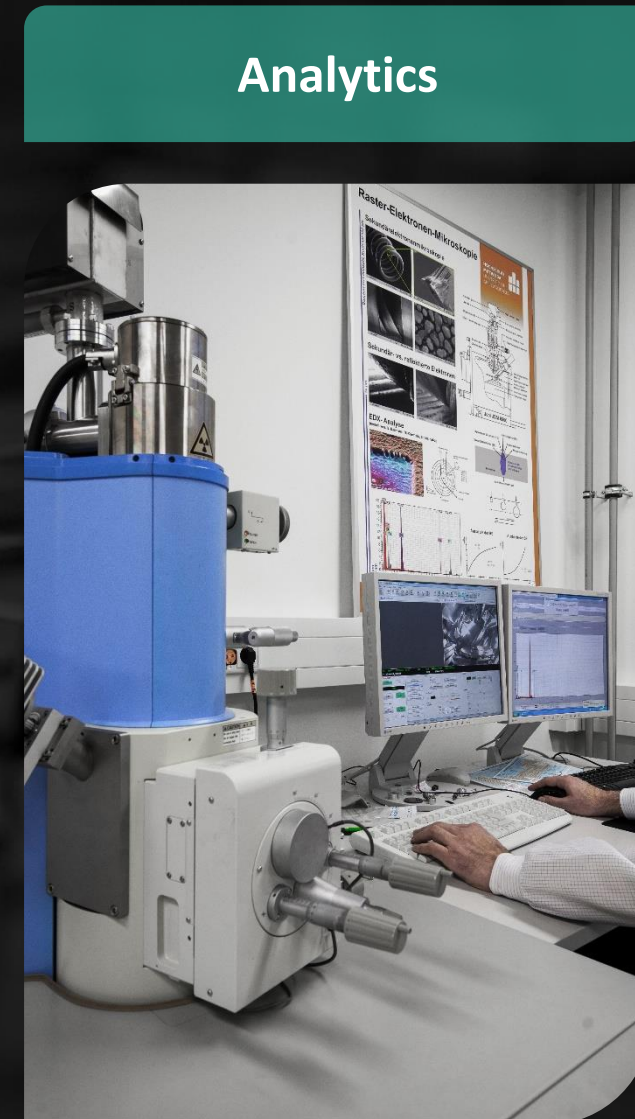
We offer



Job Coating & Sampling



Consulting



Coating Systems

Fields of Application



TOOLS



COMPONENTS



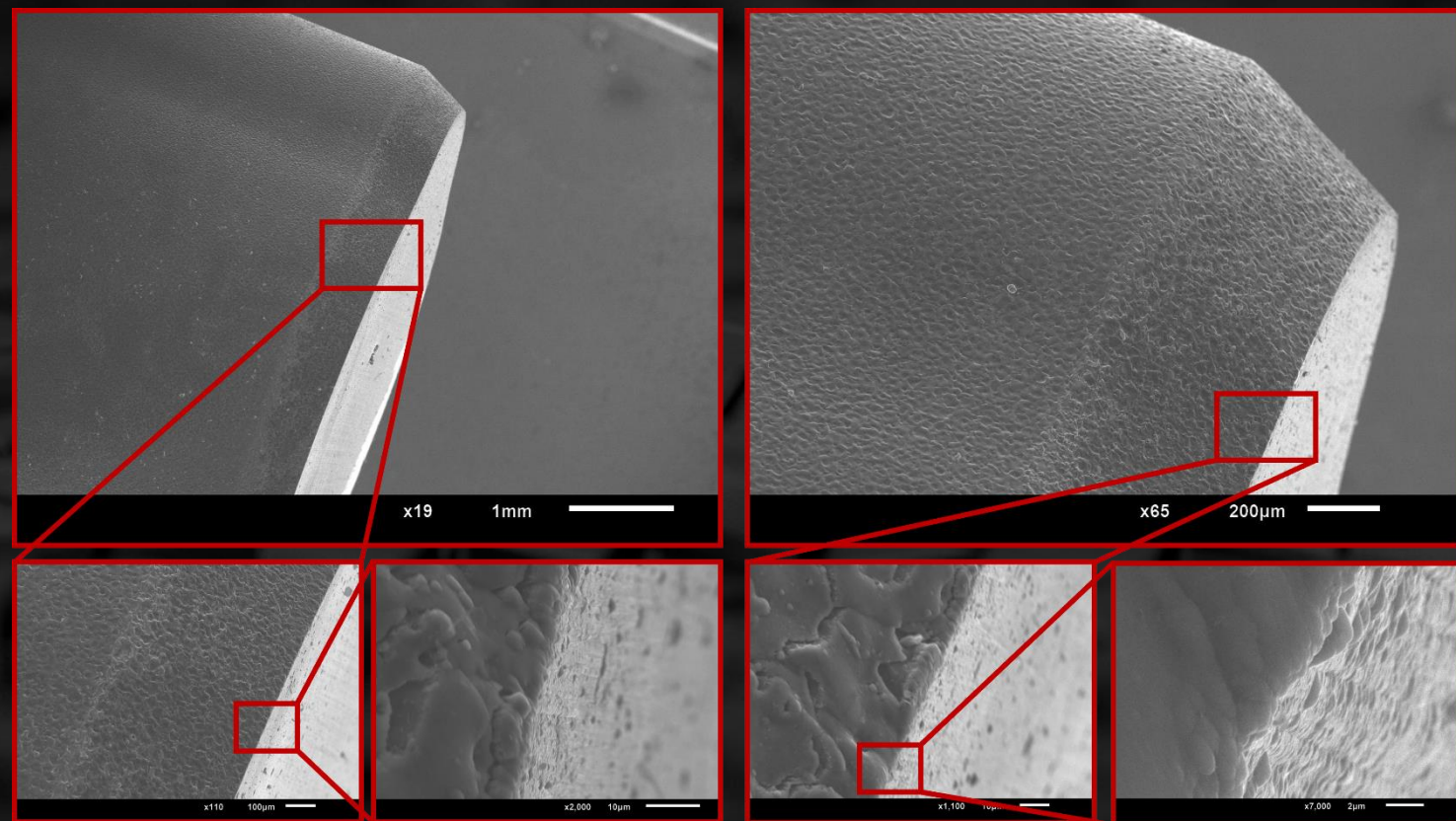
AUTOMOTIVE



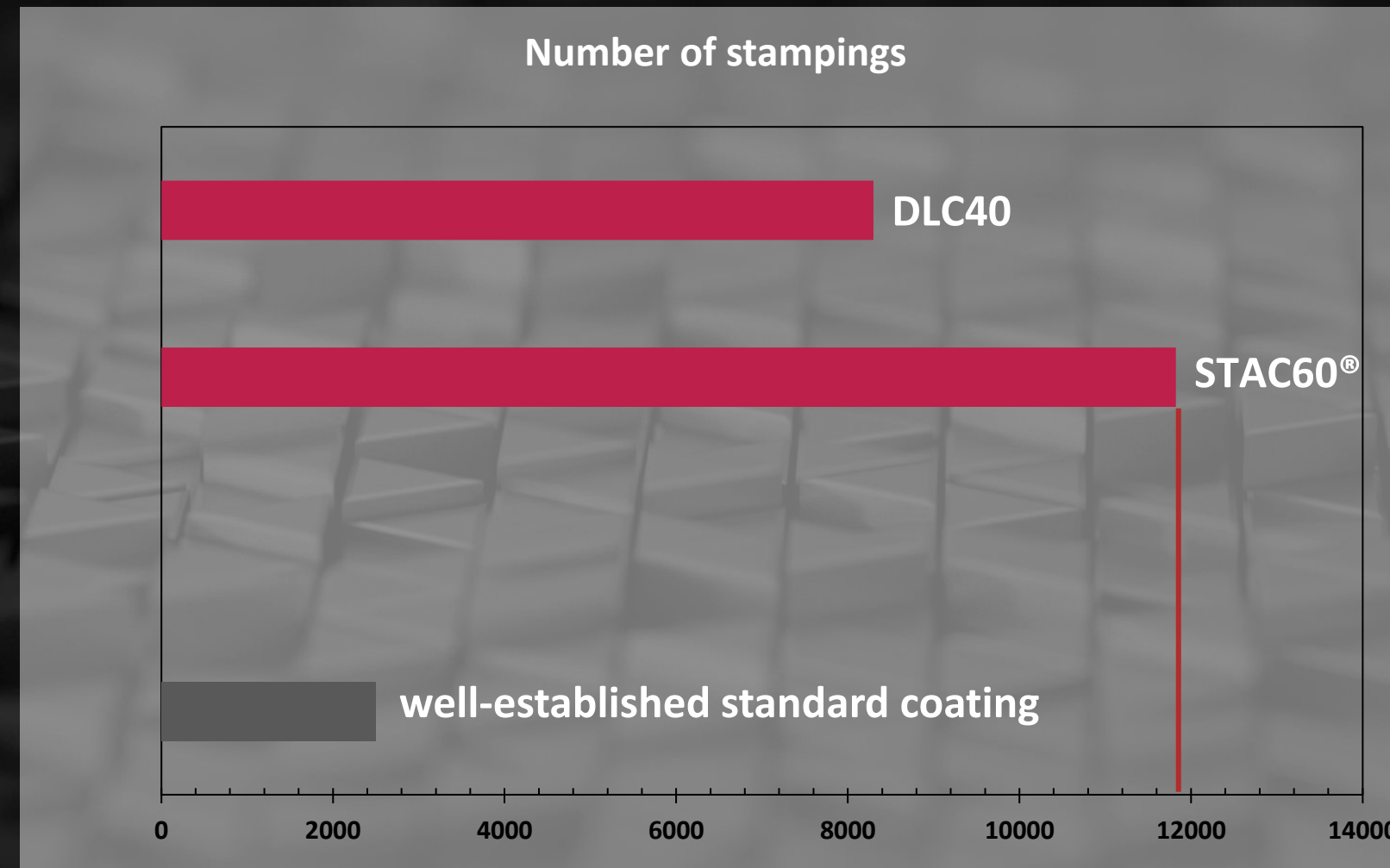
**FOOD &
PHARMA**

Tool Service Life in Stamping ANTACON vs. Market Competitors

Material: Duplex steel (thickness 4 mm)



uncoated (left) vs. coated stamp (right, lateral and frontal)



Comparison of the achieved performance of tested coatings

Factor 4,7
more life time



Advantages & Benefits

Excellent wear protection with sharp edges, prevention of the build-up of punching grade as well as reduction of friction forces for punching thin as well as up to 5mm thick material and reduction of lubrication requirements. Increase of tool life and saving of material resources

Hydrodynamic Mandrel

Advantages

- ▶ very good adhesion due to unique deposition technology
- ▶ high dynamic load capacity due to high hardness and simultaneous toughness (elongation up to 5 % possible)
- ▶ high alternating dynamics due to patented relaxation process

Benefits

- ▶ increase in production quality due to superior dimensional accuracy for exact concentricity through precise layer application by means of laser deposition
- ▶ Transmission of constantly high torques due to extreme wear resistance
- ▶ Service life increase > factor 5
- ▶ massive savings of direct & indirect costs

More applications

- ▶ Clamping collets, chucks, clamping sleeves, chuck jaws

Standard



ANTACON
sTAC60®



Number of cycles | ▷ **8.000**

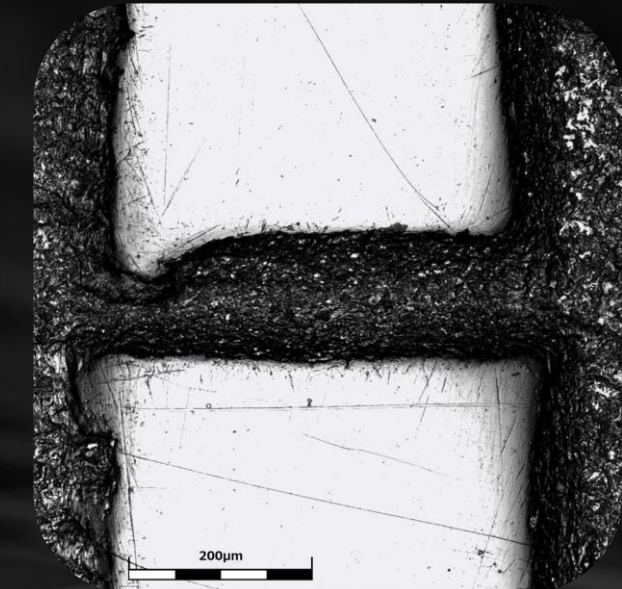
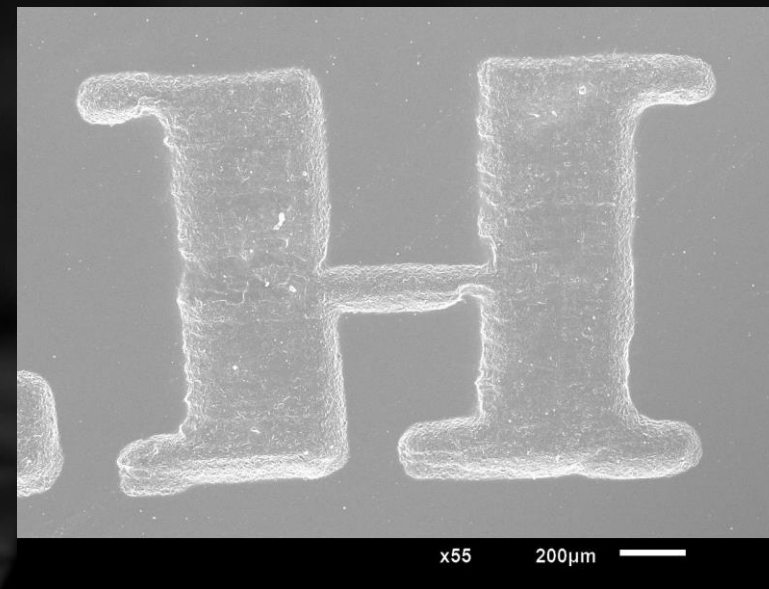
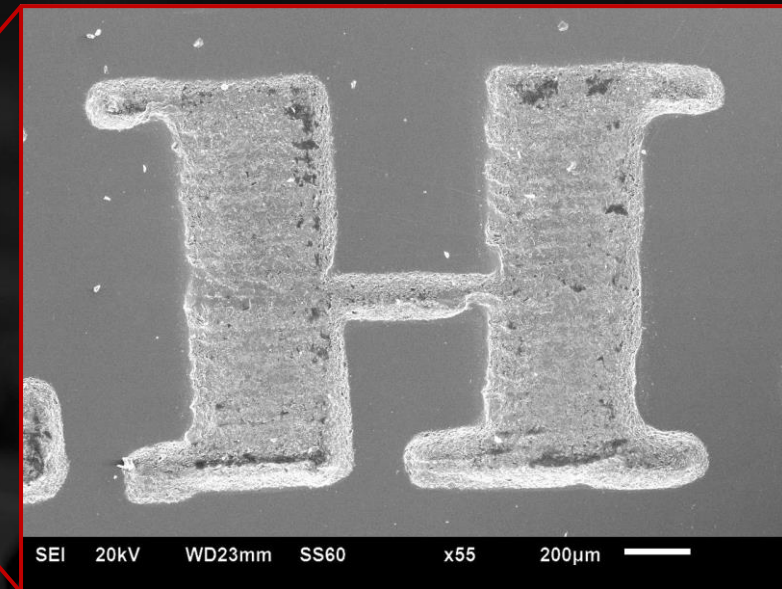
worn out

40.000 !

without failure!

Tool for clamping cams, gear wheels, hubs or turbine blades for final processing

Non-stick Embossing Stamps for Coins



Stamp with silver adhesions without coating

Cleaned and coated stamp (unused) with **sTAC60[®]** coating

Stamp cutout of the letter H after 150 mintings

- no adhesion of silver
- no detectable wear

Advantages & Benefits



- Avoidance of sticking during stamping due to non-stick effect
- Reduction of additional work such as repolishing the stamp surface
- Improved embossing compared to uncoated steel stamps
- Increased service life (factor **20!**) and savings in material resources

Precision Center Tips

Advantages

- ▶ outstanding dimensional stability due to precise coating application
- ▶ very high wear resistance
- ▶ due to low process temperature $< 90^{\circ}\text{C}$ - coating of solid and rotating or oil-filled tips / no distortion or decrease in hardness

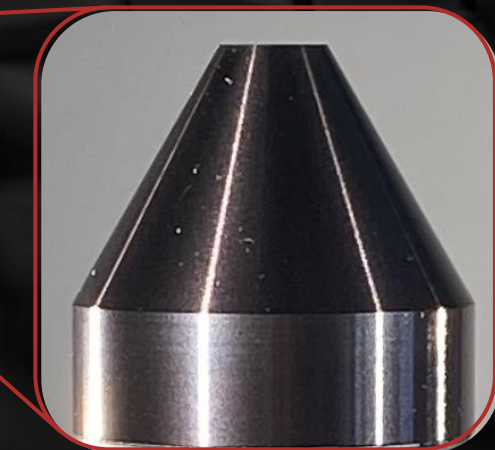
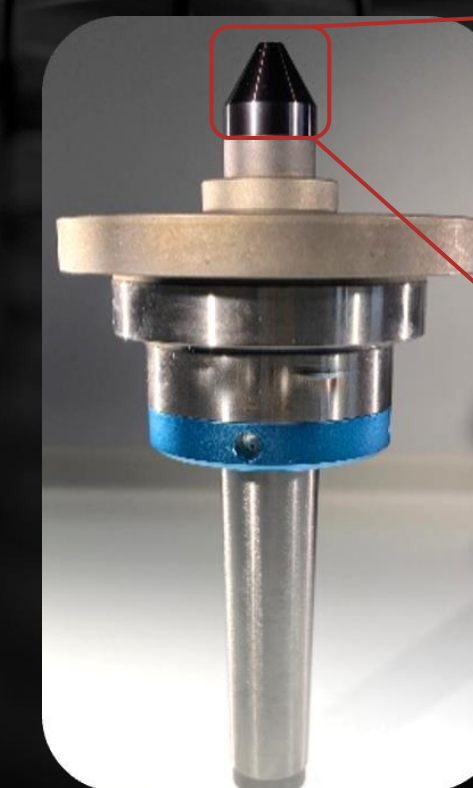
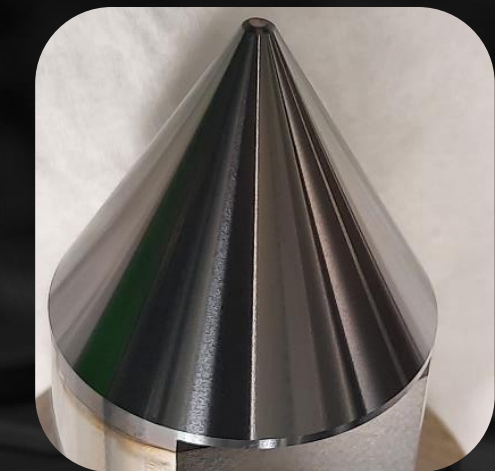
Benefits

- ▶ extreme cost savings due to tool life increase $>$ factor 4
- ▶ Reduction of additional work such as regrinding, inspection of dimensional accuracy & precision & logistics
- ▶ Reduction of the number of cost-intensive replacement tips in stock
- ▶ Reduction of scrap and increase of productivity Improved performance of new and reconditioned tips

uncoated



ANTACON
sTAC60®



Oil-filled measuring
tip with sTAC60®
coating

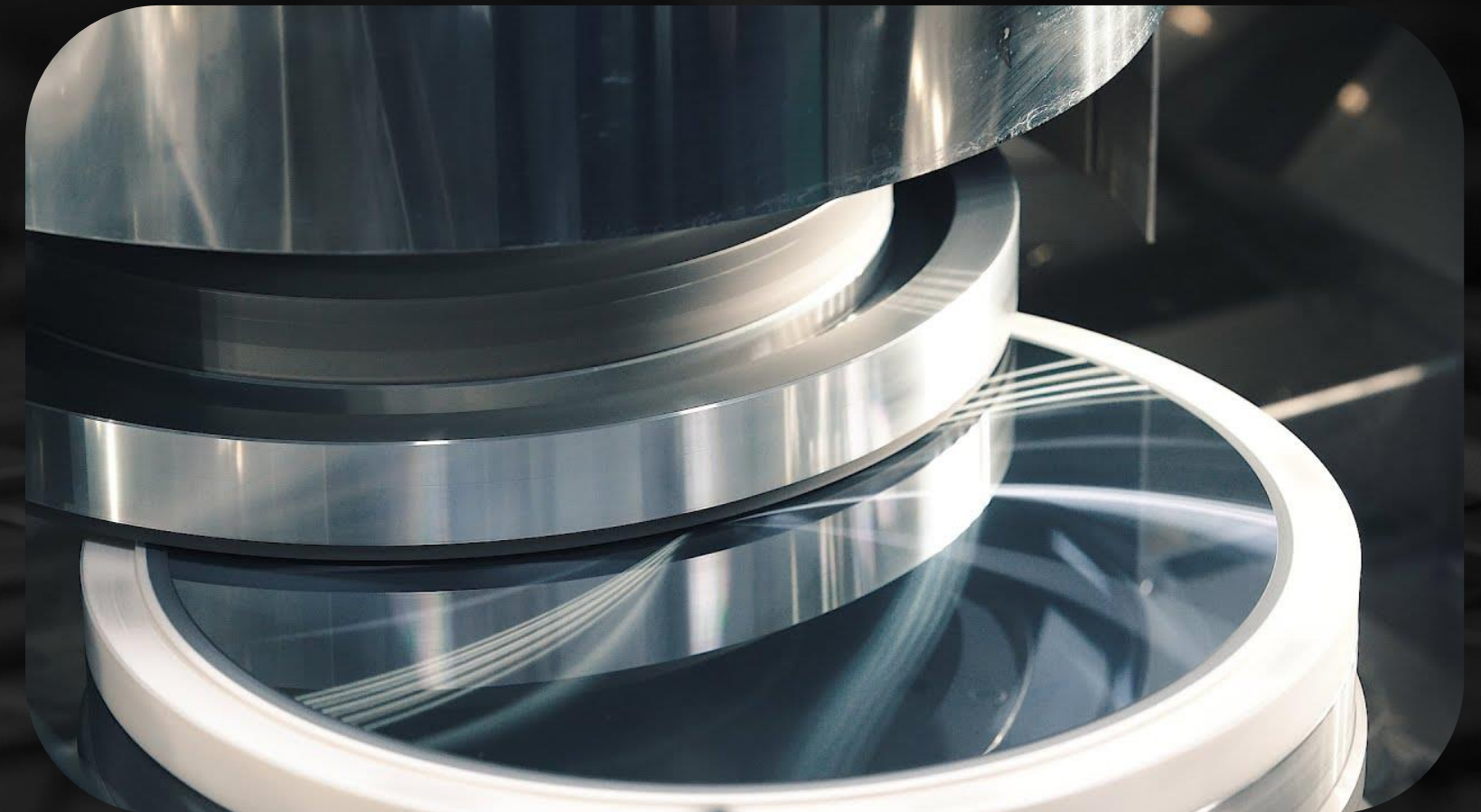
Wafer Chucks and Grinders

Advantages

- ▶ outstanding dimensional stability due to absence of internal stress
- ▶ ultra precise layer thickness - layer thickness variation < 5%
- ▶ low average roughness < 30 nm

Benefits

- ▶ extreme cost savings due to tool lifetime increase
- ▶ reduction of additional work such as masking like in other coating technologies
- ▶ reduction of the number of cost-intensive replacement tools in stock
- ▶ better process stability



Valve Seats

Advantages

- ▶ high impact-resistance
- ▶ barrier effect against aggressive media
- ▶ high dynamic load capacity due to high hardness and simultaneous toughness

Benefits

- ▶ Super-smooth sealing surface to improve sealing performance combined with no change of locating surface
- ▶ increased service life and reduced replacement costs
- ▶ reduction of the risk of system failure and improvement of the energy efficiency

More applications

- ▶ quick switching valves and valve components for gases and other media, sealing surfaces

sTAC60[®] coated valve seat



starting condition



after 10 Mio.
number of cycles

> 100 Mio. cycles can be predicted

Precision Shafts

Advantages

- ▶ excellent abrasive and adhesive wear protection even with minimum quantity lubrication or dry
- ▶ Good resistance to sliding wear
- ▶ Adjustment of fit in the sub-micrometer range possible

Benefits

- ▶ Increased service life and reduced replacement costs
- ▶ Reduction of the risk of system failure and increase in productivity
- ▶ Improvement of the energy efficiency of the overall system

More applications

- ▶ Bearing seats for spindle shafts, calibration masters, High speed applications, various spindles and shafts, etc.



sTAC60[®] coated shafts

Think Harder – Less Wear and Tear



ANTACON GmbH

Schillerstraße 10
09648 Mittweida
Germany

phone: +49 (0)3727 9592951
e-mail: info@antacon.de
web: www.antacon.com

We look forward
to raising your application
to the next level!

Just contact us.

Awards:



Partners:



Anton Paar



ACOD
AUTOMOTIVE CLUSTER
OSTDEUTSCHLAND