MAKE LIDAR WORK

GXC PROTECTS LIDAR COVERS

WITH FUNCTIONAL TRANSPARENT WET COATINGS

DVN LIDAR
CONFERENCE
03 DEC 2019

FLORIAN
HAACKE

Dr. SARAH
WÖLPER

GXC COATINGS –
COATINGS TO KEEP TRANSPARENCY ON GLASS AND PC COVERS

- GXC develops, manufactures and applies transparent high-performance coatings for new applications

- All parts that should stay transparent will stay transparent through GXC's coatings, e.g.
  - Windshields in Electric Vehicles (passive de-fogging without energy consumption)
  - Exterior sensor and camera covers in Autonomous Vehicles and
  - Interior camera covers for driver monitoring and shared driving
  - Industry sensors for automization and as "eyes" of artificial intelligence

- 20 years of experience in automotive, optical and lighting industries
- ISO 9001:2015 and ISO 14001:2015 certification - IATF 16949 in preparation (2021)
- GXC is a fast growing, innovative enterprise active in growth markets

BACKGROUND AND OUTLOOK

2000
Founding of GXC in Goslar, Germany
1st coating line (glass)

2007
Diversification to polymer coatings
Antifog/Polycarbonate (PC)

2010
Hardcoat/PC
2nd coating line
Patent filings

2017
Additional function coatings
ETC/AFP/AR
3rd coating line (SC)

2020/2021
Expansion/CAPEX for ADAS, EV and AI sensoring

GXC COMPETENCIES

DEVELOPMENT

- International patents
- 3 chemical laboratories
- Antifog, hardcoat, hybrids and additional functions like anti reflective, easy to clean, etc.
- Protected application technologies (2in1)

MANUFACTURING (COATING MATERIAL)

- Manufacturing of liquid coating materials
- Capacitites several tons/a
- Contract research and joint development agreements (JDA) with international partners

APPLICATION (COATING SERVICES)

- 3 automatic coating lines
- PST- Precision Spray Technology
- Homogenous coating layers
- Masking is possible
- Clean Room Claas 4-5
- Automotive Standards

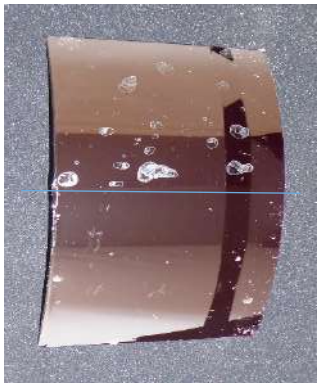
GXC FUNCTIONAL COATINGS

ANTI FOG

- Automotive lighting
- Autonomous driving
- Instruments, cameras
- Industrial sensors
- Helmet visors

HARDCOAT (INTERIOR)

- Driver monitoring
- HMI touch elements
- Optical sensors
- Mirrors, ophtalmics
- Helmet visors

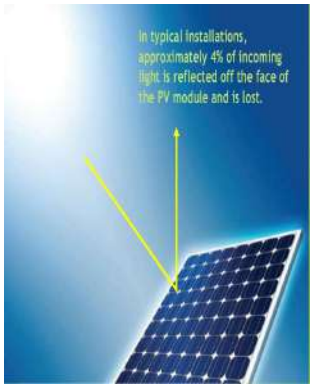


HARDCOAT (EXTERIOR)

- LIDAR covers
- Touch instruments
- Cameras, lighting
- Traffic surveillance
- Architecture

ANTI DIRT

- Auto exterior parts
- Autonomous driving
- Instruments, displays
- Ext sensors, lighting
- Reflectors



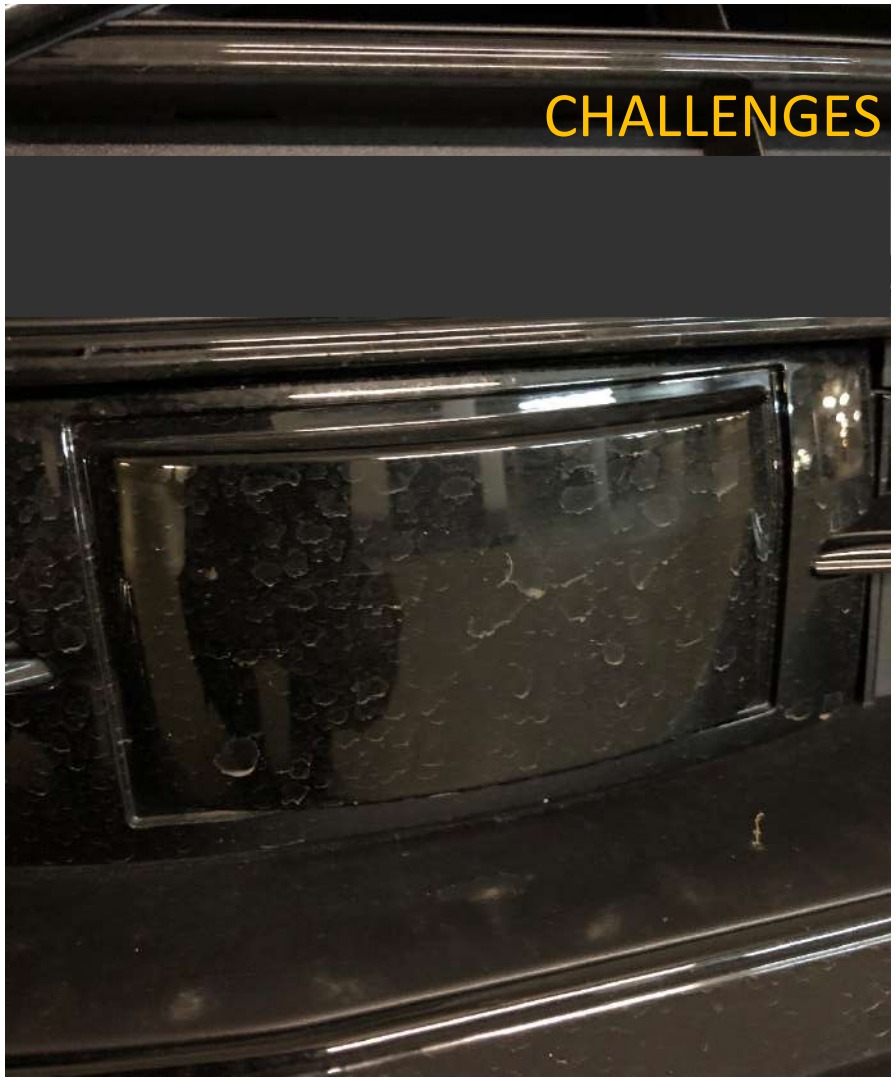
ANTI REFLECTIVE

- PC-IR covers
- Glass IR covers
- Optical lenses
- Medtech
- Photovotaics

GXC PROTECTS LIDAR COVERS

TEST RESULTS

LABORATORY AND REAL LIFE



CHALLENGES FOR LIDAR COVERS

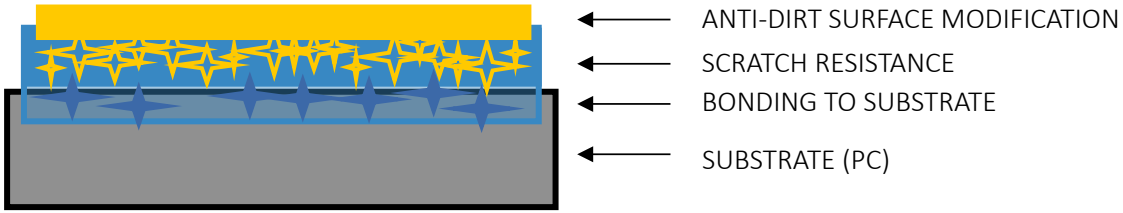
PROTECTION FROM ENVIRONMENT

1) DIRT, DUST, INSECTS
2) MECHANICAL
3) CHEMICAL
4) WEATHERING
5) FOGGING INSIDE
6) ICING

EFFICIENCY (TRANSMISSION)

1) REFRACTIVE INDEX MATCHING OF SUBSTRATE AND COATING
2) ANTI-REFLECTIVE PROPERTIES @905nm
3) THIN, HOMOGENOUS COATING LAYER

GXC NuGLASS® HCPX ANTI DIRT HARDCOATS



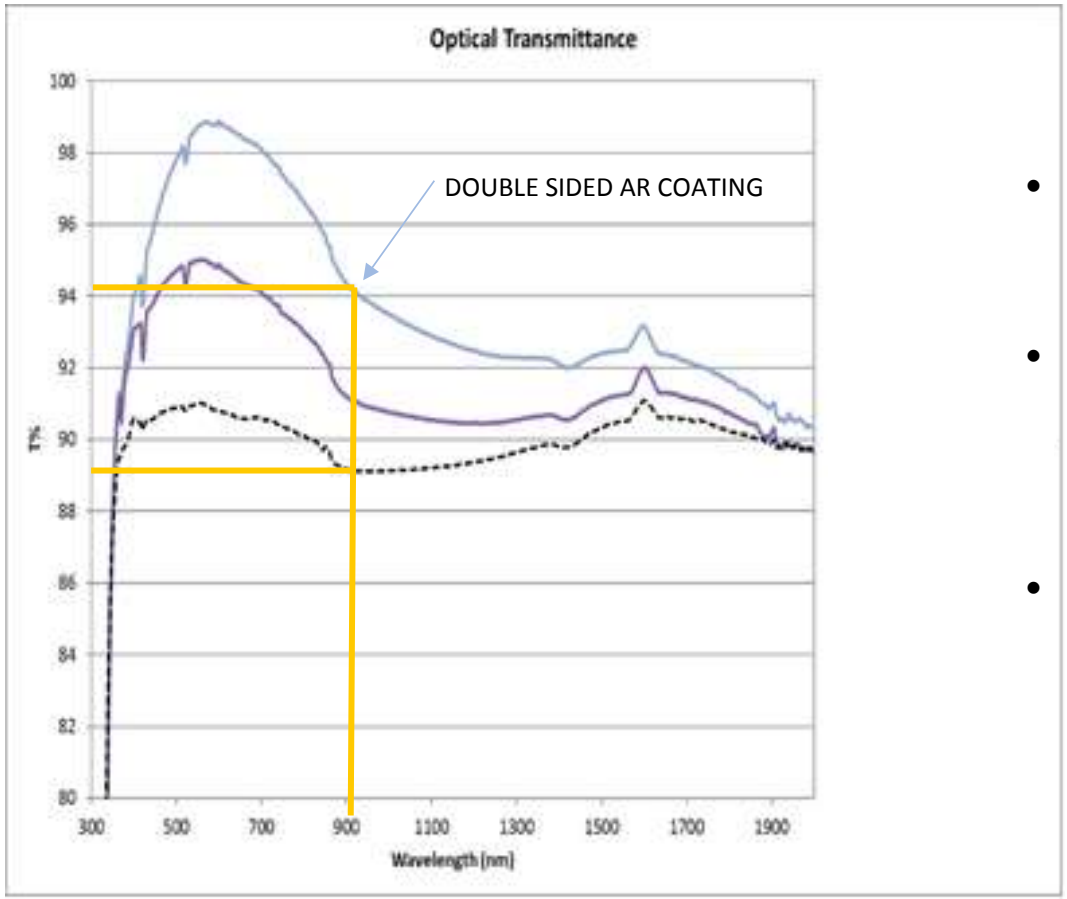
SPECIFICATION/CHALLENGE	TECHNICAL SOLUTION
HEADLAMP/OUTSIDE SENSOR	(IR-) TRANSPARENCY FOR PC/PMMA
SCRATCH RESISTANCE	PU BASE AND SCRATCH ADDITIVES
ANTI DIRT – NO DIRT ADHERENCE	SMOOTH – SOLID SURFACE MORPHOLOGY
CLEANING	LOW SURFACE ENERGY
COATING APPLICATION	3D PRECISION SPRAY COATING
SUSTAINABILITY	UV CURING – THIN LAYERS
DURABILITY	CROSS LINKING
WEATHERABILITY	UV STABILIZATION

GXC ANTI DIRT HARDCOAT PERFORMANCE AFTER TL211 TESTING

TEST SPEC	TEST RESULT
ADHESION, DIN EN ISO 2409	0
CLIMATE CYCLING, TL 211, PV 1200 – 20 CYCLES	OK, 0, OK CA_{H2O}: 108 °; CA_{HD}: 61 °; 16 mN/m
TEMPERATURE RESISTANCE, TL 211	OK, 0, OK
CHEMICAL RESISTANCE, TL 211	OK
LAYER THICKNESS HOMOGENITY [µm]	10-12
CLEANABILITY CONTACT ANGLE, SURFACE ENERGY	CA_{H2O}: 109 °; CA_{HD}: 61 °; 15 mN/m
SCRATCH RESISTANCE, TL 226	ok
HYDROLYSIS, TL 226	OK, 0, OK CA_{H2O}: 105 °; CA_{HD}: 61 °; 17 mN/m

→ DEVELOPMENT – PARALLEL TESTING IN LABORATORY AND REAL LIFE
→ COMBINATION OF COATING FORMULATION AND COATING APPLICATION

ANTI REFLECTIVE +5% TRANSMISSION TO GLASS@905mnm

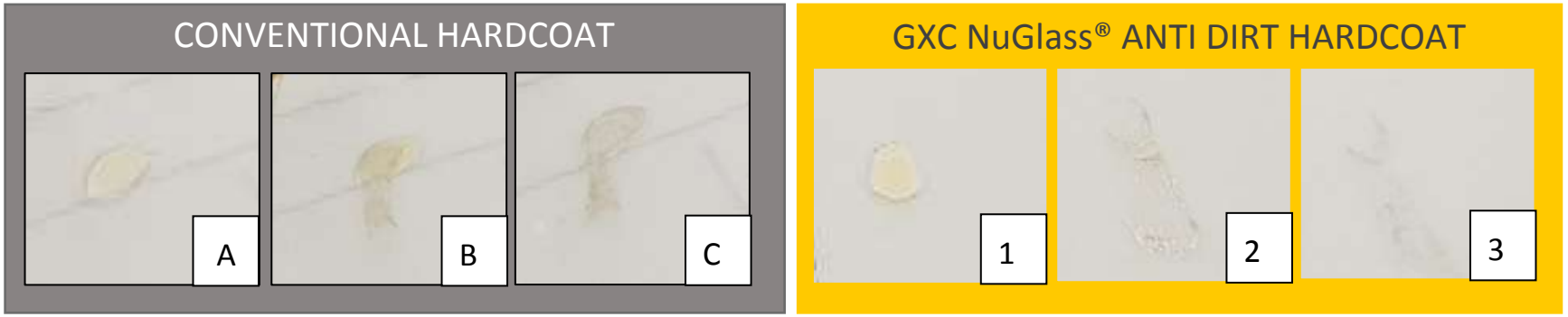


- GXC DOUBLE SIDED ANTI REFLECTIVE COATING ON GLASS
- FOR 2D AND 3D SHAPES
  - DIP COATING
  - FLOW COATING
- DEVELOPED FOR EXTERIOR APPLICATIONS - HIGH RESISTANCE TO WEATHERING AND ABRASION

ANTI DIRT – LABORATORY SIMULATION OF DIRT ADHESION

ARTIFICAL DIRT TESTING PERFORMED WITH:

- → TREE GUM (LIQUID PITCH) – see below
- → ECE R45 DIRT SUSPENSION
- → WATER
- → INSECTS

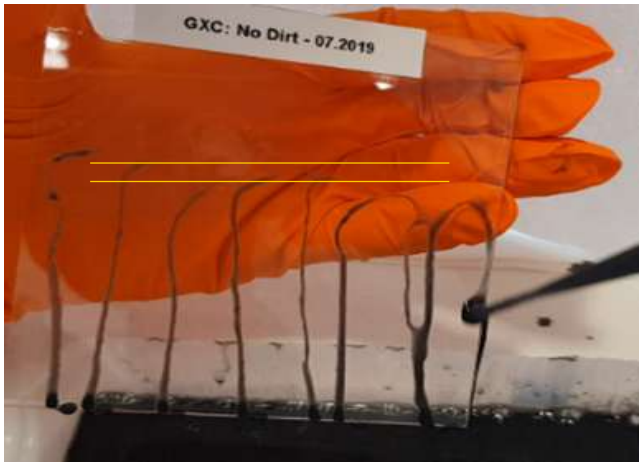


TREE GUM	AFTER DRY WIPE	AFTER WATER WIPE	TREE GUM	AFTER DRY WIPE	AFTER WATER WIPE

ANTI DIRT – RUN-OFF SPEED AND ADHESIVE FORCES WITH ECE R45 DIRT SUSPENSION

CONVENTIONAL HARDCOAT

- BLURRED DIRT CUT-OFF
- RUN OFF IN 13 SECONDS
- LARGE DIRT COVERED AREA



GXC ANTI DIRT HARDCOAT

- CLEAR DIRT CUT-OFF
- RUN OFF in 3 SECONDS
- NO DIRT COVERED AREA

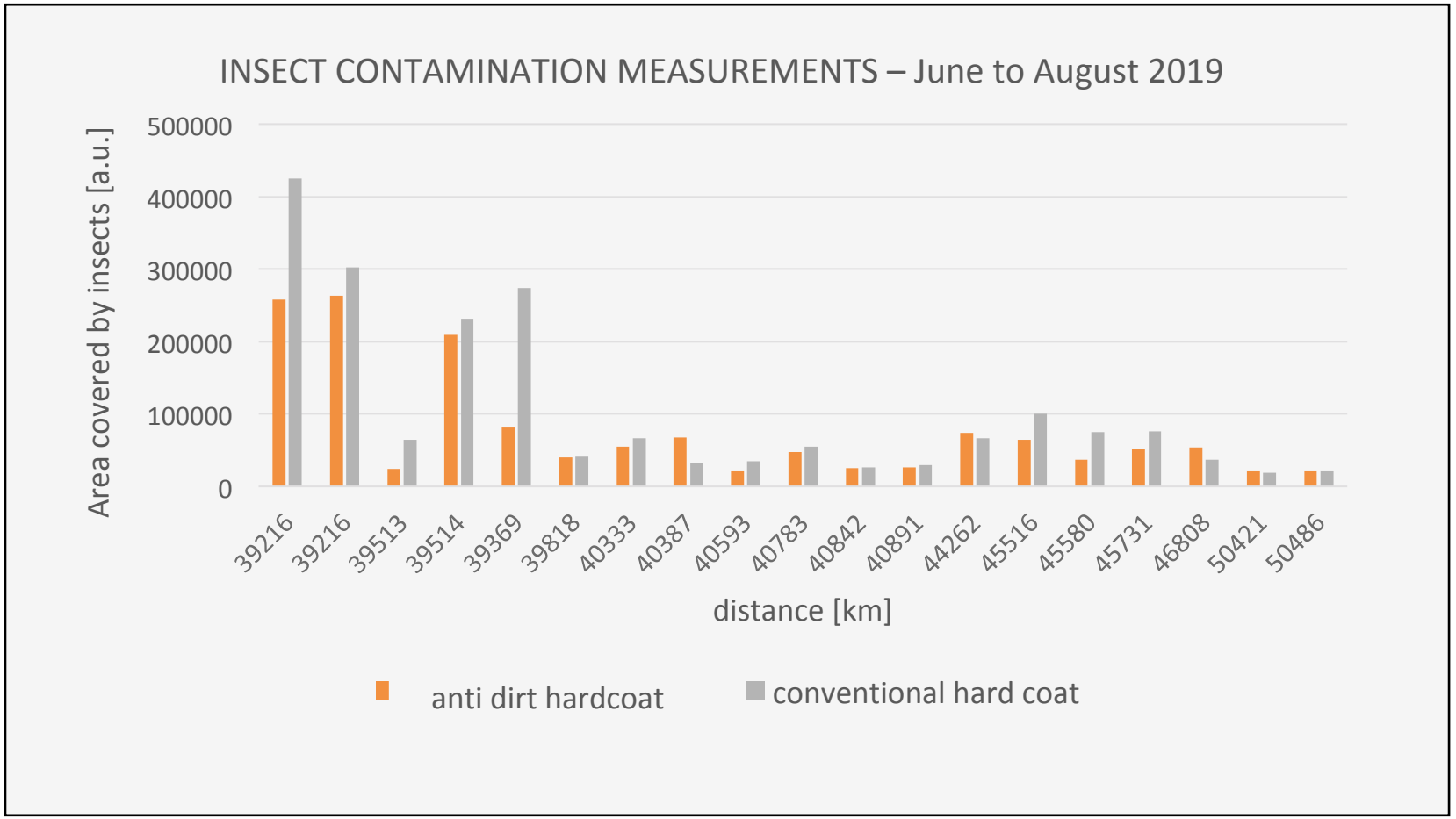
→ HIGH RUN-OFF SPEED MEANS LESS TIME TO BUILD ADHESIVE FORCES

→ NO LASTING DIRT COVERAGE ON THE GXC ANTI DIRT HARDCOAT

REAL LIFE TESTING - GXC TEST CAR

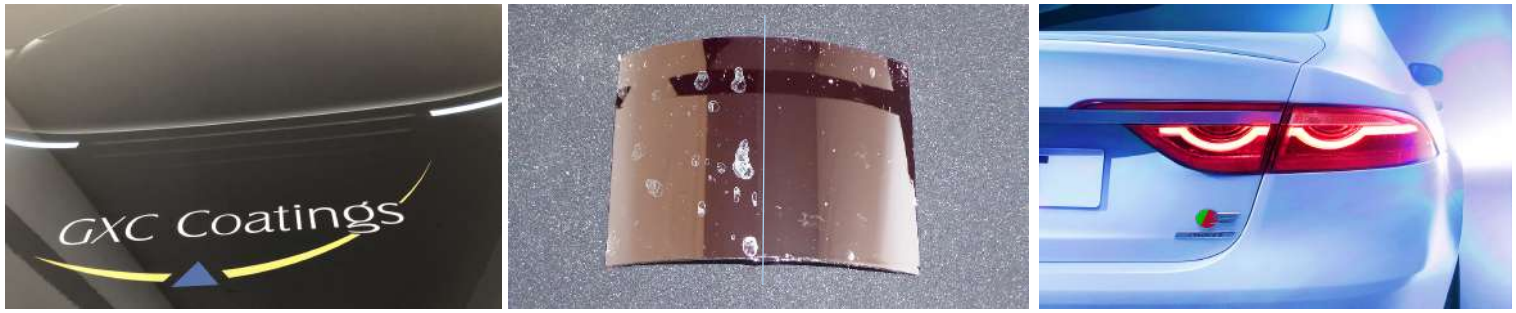
DRIVING TESTS VARIOUS EXTERIOR PARTS COATED

REAL LIFE TEST RESULTS -
45% REDUCTION OF INSECT CONTAMINATION



TESTED ON GXC SHOW CAR OVER 24,700 KM IN CENTRAL EUROPE – WASH CYCLES – RAIN – ELEVATED TEMP
AVERAGE DIGITAL AREA MEASURE OF SURFACE COVERAGE BY INSECTS AND OTHER DIRT PARTICLES

SUMMARY OF GXC LIDAR COVER PROTECTION



- GXC DURABLE ANTI-DIRT HARDCOATS - MINUS 45% INSECT COVERAGE
  - ✓ ANTI-DIRT FUNCTION PROVEN IN LABORATORY AND DRIVING TESTS
  - ✓ MAKES CLEANING EASIER, LESS OFTEN
  - ✓ DURABILITY PROVEN, FLEXIBLE, SCRATCH RESISTANT COATING
  - ✓ WEATHERING STABILITY PASSED INTERNAL ACCELERATION TESTS

- GXC ANTI REFLECTIVE COATINGS – PLUS 5% TRANSMISSION@905nm
- GXC ANTI FOG COATING – DURABLE INSIDE DE-FOGGING

- GXC PATENT PENDING No. 10 2019 124 648.2

TRANSPARENCY IN COOPERATION !

GXC Coatings

Dr. Sarah Wölper (Head of R&D) - Florian Haacke (Chairman)
Im Schleeke 27-31 I D-38642 Goslar I Germany
Phone +49.5321.34 30-74
info@gxc-coatings.de

www.gxc-coatings.com