O C Si Al

carbon
nanomaterials
for the global
industry

纳米力技术
NANO POWER ECHNOLOGY

OCSiAl:
redefining materials, reinventing technologies

28.04.2014

FROM WHERE IT ALL BEGAN

carbon nanomaterials for the global

MIKHAIL PREDTECHENSKY

Senior vice-president, OCSiAl

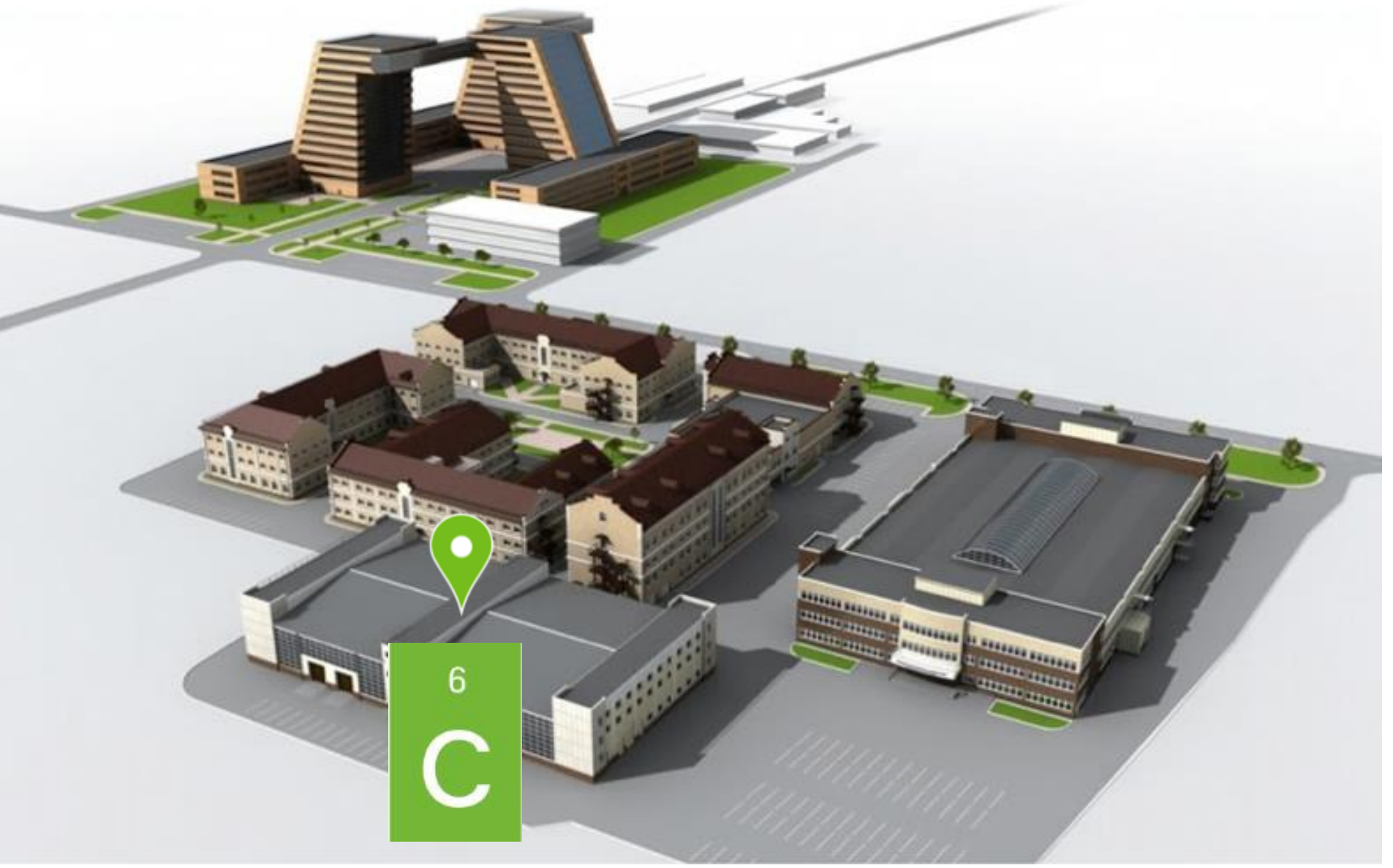
Corresponding member of Russian Academy of Science, Professor. Inventor of the plasmachemical reactor and Head of the technical part of the project. Realized some R&D projects for large international corporation such as: Hewlett Packard, Samsung, Air Products & Chemicals, etc.

OCSiAl GROUP: WORLDWIDE

carbon nanomaterials for the global

OCSiAl FACILITY: TECHNOPARK IN NOVOSIBIRSK

carbon
nanomaterials
for the global



OCSiAl FACILITY: TECHNOPARK IN NOVOSIBIRSK

- Since 2010
- USD 50 mln. of total investments
- 4 200 sq. meters
- More than 150 employees

OCSiAl FACILITY: TECHNOPARK IN NOVOSIBIRSK

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NPT 纳米力技术 NANO POWER ECHNOLOGY

OCSiAl carbon nanomaterials for the global

ONE ADDITIVE FOR THOUSANDS OF MATERIALS

TUBALL®: FEATURES

carbon nanomaterials for the global

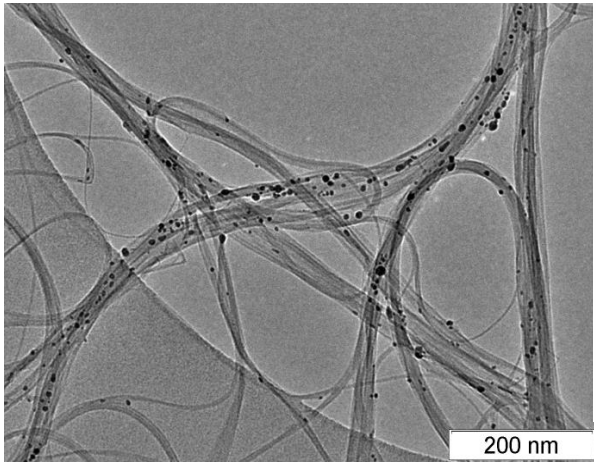
- High “as-produced” single wall carbon nanotube content (~75%);
- Extremely low amount of amorphous carbon (<1%);
- Encapsulation of virtually all inorganic (Fe) impurities;
- High crystallinity of nanotubes;
- High G/D purity ratio (>50);
- Extremely low price for this grade of single wall carbon nanotubes.

TUBALL®: TECHNICAL DATASHEET

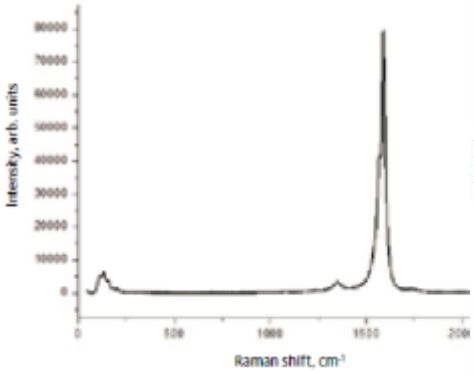
carbon nanomaterials for the global

Specifications	Unit of measure	Value	Method of evaluation
Carbon content	wt.%	~ 85	TGA, EDX
CNT	wt.%	~ 75	TGA
Number of layers CNT	unit	1 – 2	TEM
Outer mean diameter CNT	Nm	1 – 2	Raman, TEM
G/D ratio	unit	~ 50	Raman
Metal impurities	wt.%	~ 15	EDX, TGA
BET Surface Area	$m^2/g.$	~ 400	BET

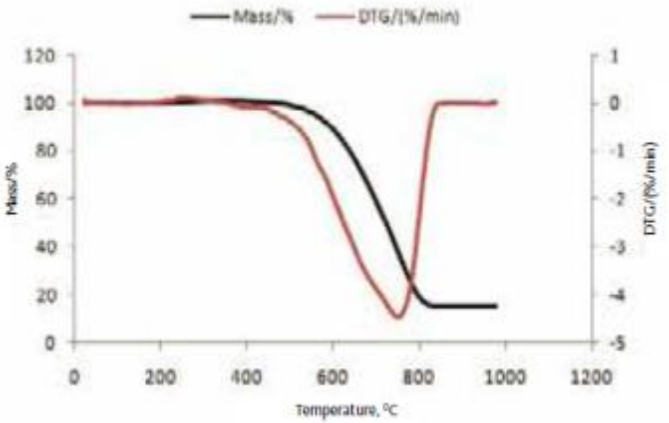
TEM image



Raman spectrum



TGA curves



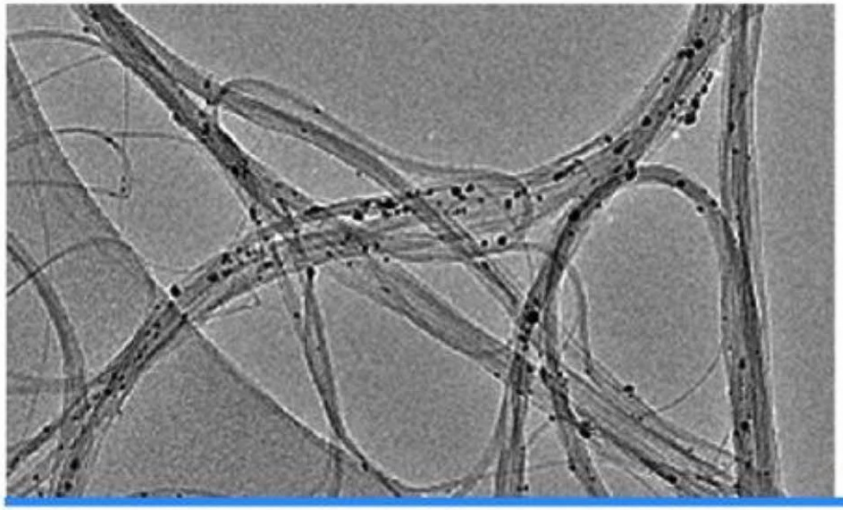
TUBALL®: PACKED PRODUCT

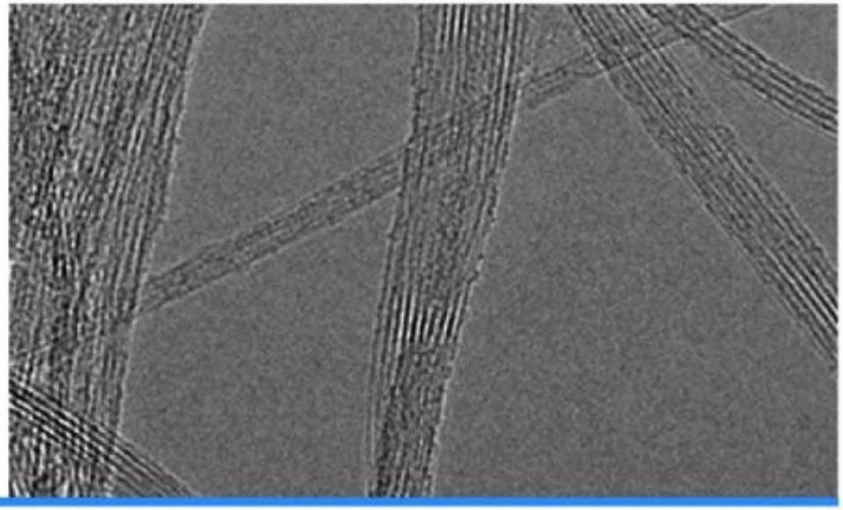
NPT 纳米力技术 NANO POWER ECHNOLOGY

OCSiAl carbon nanomaterials for the global

carbon nanomaterials for the global

TUBALL®: TECHNICAL DATA SHEET





SPECIFICATIONS	UNIT OF MEASURE	VALUE	METHOD OF EVALUATION
Carbon content	wt.%	~ 85	TGA, EDX
CNT	wt.%	~ 75	TEM, TGA
Number of layers CNT	unit	1 – 2	TEM
Outer mean diameter CNT	Nm	1 – 2	Raman, TEM
G/D ratio	unit	~ 50	Raman
Metal impurities	wt.%	~ 15	EDX, TGA
BET Surface Area	$m^2/g.$	~ 400	BET

OCSIAL: PRIORITY AREAS AND PRODUCTS

carbon nanomaterials for the global

TRANSPARENT CONDUCTIVE FILMS

- *Tuball Ink*

POLYMER COMPOSITES

- *Tuball Composites*

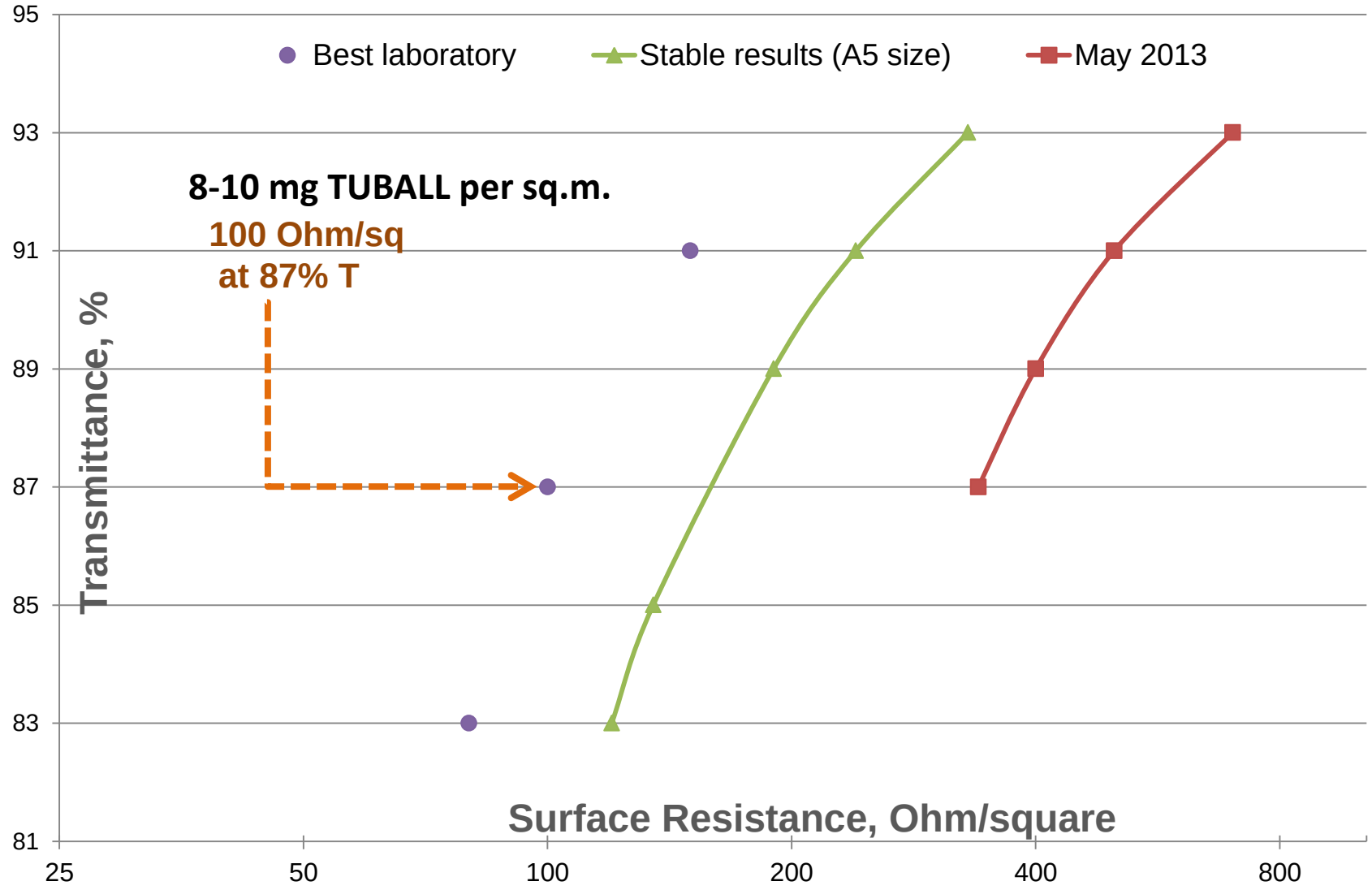
ELECTROCHEMICAL CELLS

- *Tuball Batt*

ELASTOMERS

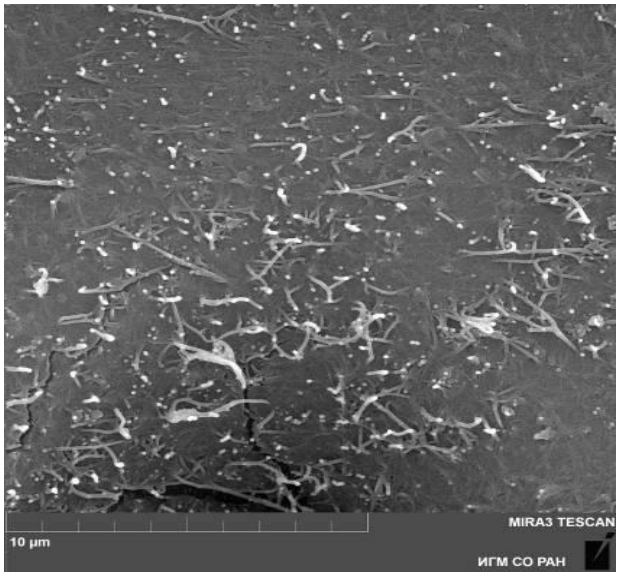
- *Tuball Tirer*

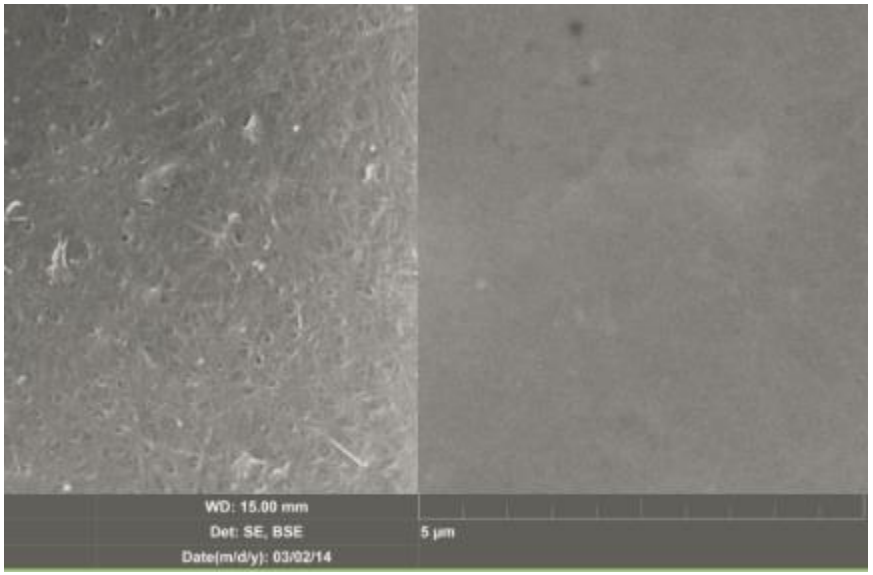
TRANSPARENT ELECTRODES: OUR RESULTS



TRANSPARENT ELECTRODES: OUR SAMPLES

carbon nanomaterials for the global





Specifications	Unit of measure	Value
Sheet Resistance	Ohm/square	~ 150
Light Transmittance	%	~ 89
Haze	%	< 1
Thickness of conductive layer	nm	30-40
Substrate		PET
Conductive material		TUBALL®

TUBALL BATT: READY-TO-USE ADDITIVE

carbon nanomaterials for the global

Tuball BATT Features:

- Easy to implement in process
- No viscosity change.
- Significant increase of li-ion cells life cycle
- Mechanical strength of the cathode material
- **For all of cathode chemistries**

TUBALL®
BATT
nanomodifier of materials
cathode

TUBALL BATT: MAKING TESTING CELLS

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Coating

Abbildung 8: Keko CAM-M1H beim IKTS Dresde

Figure 8 : Keko CAM M1H at the IKTS Dresden

Calendaring

Abbildung 9: Kalandereinheit (Fa. Saueressig) bei

Laser cutting

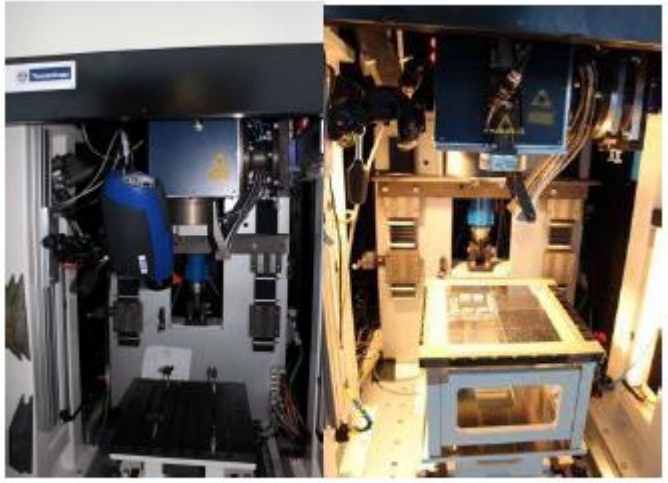

Abbildung 12: Schneidlaser Innenansicht

Figure 8: ***Cutting laser Interior***

The slurries with the 0.0%, 0,1%, 0,2% and 1% wt. SWCNT in cathode material (LFP) were prepared (approx.4kg)

Cathodes with a surface of approx. 84cm^2 and density of 10,8mg/cm^2 were made.

TUBALL BATT: TESTING RESULTS

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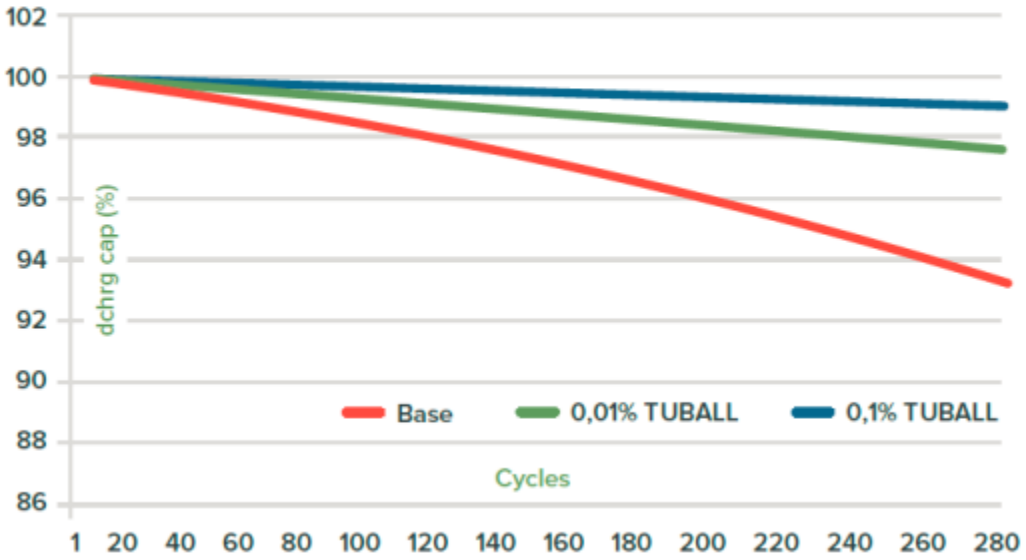
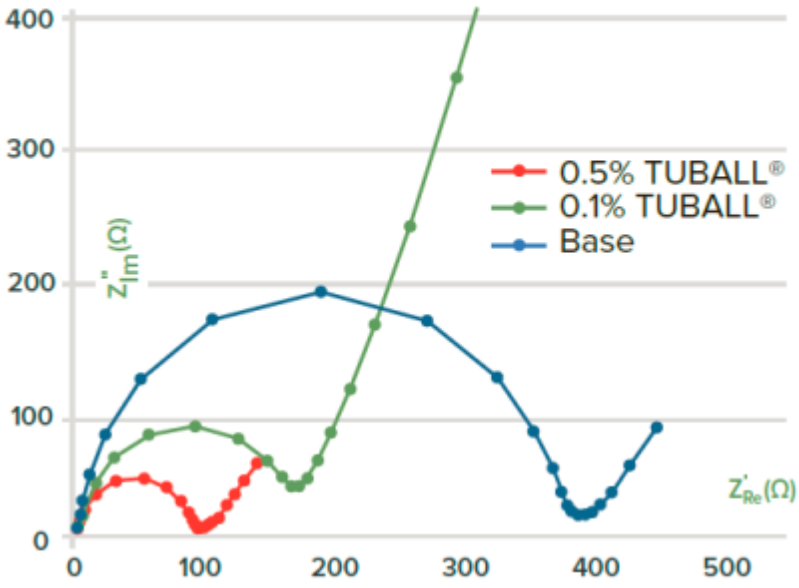
Capacity loss: Impact of the Tuball®

EFFECT ON CYCLABILITY

Cycling 0.5C – chrg 1C dchrg; 23°C; 100% DOD 100mAh pouch cell C-LFP (2.5-3.65V)



IMPEDANCE SPECTRA OF CELLS



Testing conducted by OCSiAl in 2013. The data is approximated. The data provided for descriptive purposes only and is not intended to make or imply any guarantee or warranty. Results may depend on cell type, the cathode chemistry and characteristics of the process.

ELASTOMERS: TIRES IMPROVEMENT

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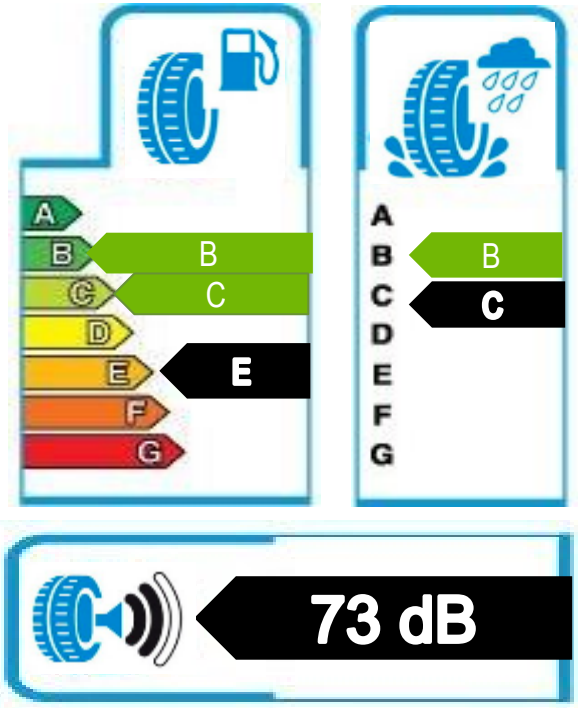
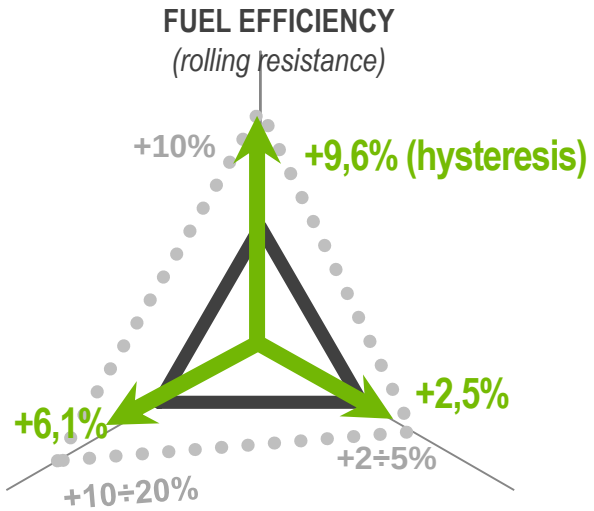
TUBALL TIRES MODIFIER
0,03% (1 g TUBALL® per 1 tire)

Kama-Euro 195/55/R15





ELASTOMERS: END PRODUCT WITH TUBALL®

Tire produced by JSC Tatneft with Tuball® masterbatch

OCSIAL: PRODUCT DEVELOPMENT

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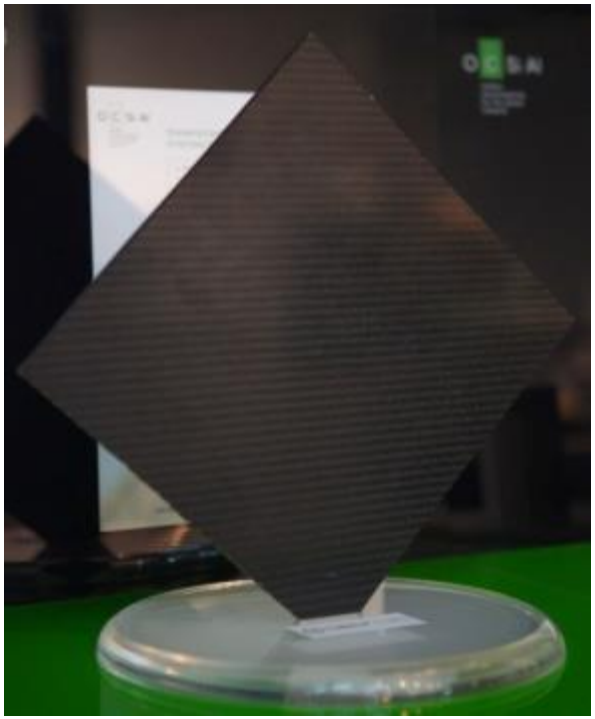
APPLICATION FOR TUBALL IN PROGRESS

COMPOSITES: CARBON FIBER REINFORCED PLASTIC

carbon nanomaterials for the global



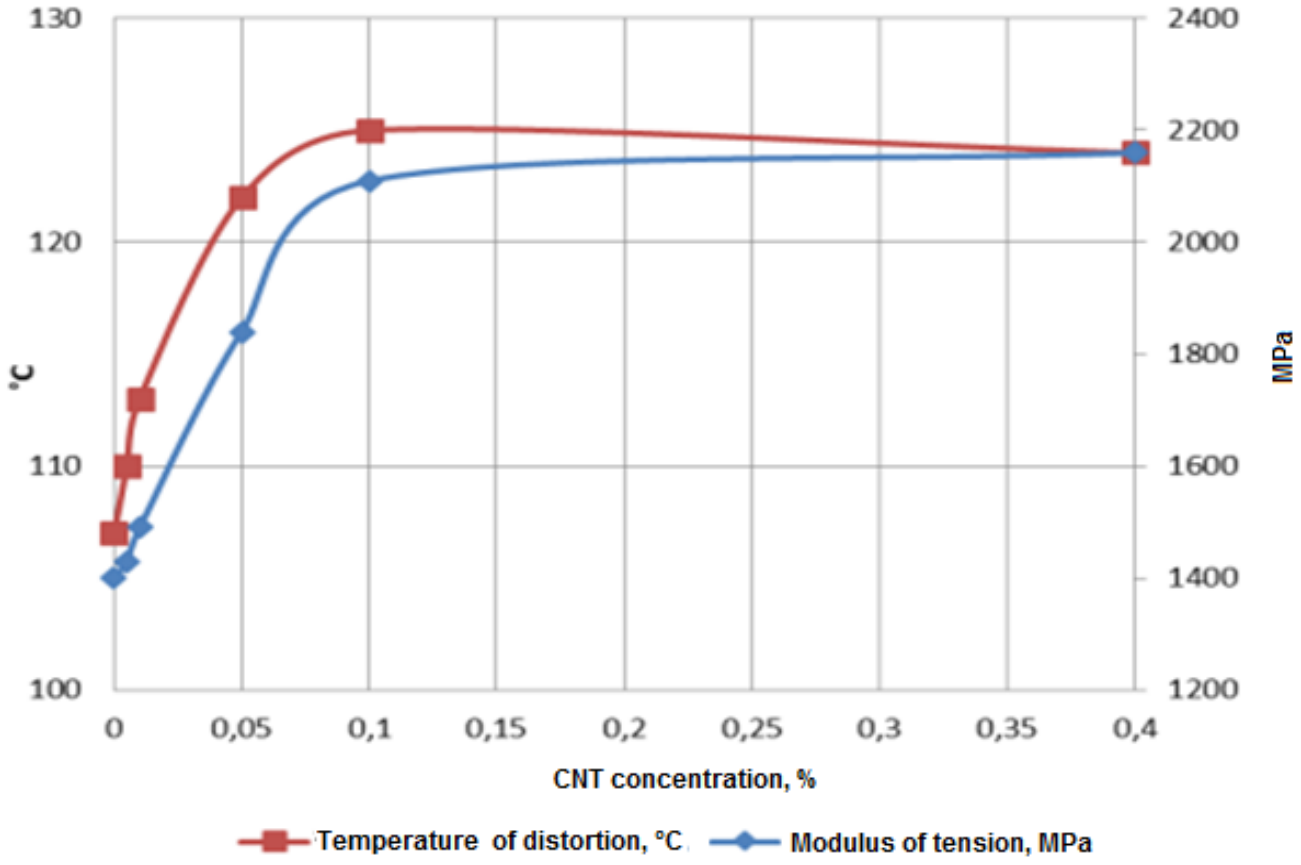
Resin	Tensile Modulus	Flexural Strength	Flexural Modulus	Compression Strength
CFRP with 0.05 wt% Kentera™ functionalized Tuball®	70,89 GPa	904 MPa	53,494 GPa	662 MPa
Control CFRP	53,78 GPa	669 MPa	50,331 GPa	552 MPa
% increase vs Control CFRP	**31,8%**	**35,1%**	**6,3%**	**19,9%**

0,05 wt.% Tuball® with Zyvex Kentera™ in the sample of CFRP

zyvex technologies

Partner in development

COMPOSITES: POLYPROPYLENE



Modulus of tension increased by 1.5 times

Temperature of distortion higher by 17° C

COMPOSITES: TUBALL® ADVANTAGES

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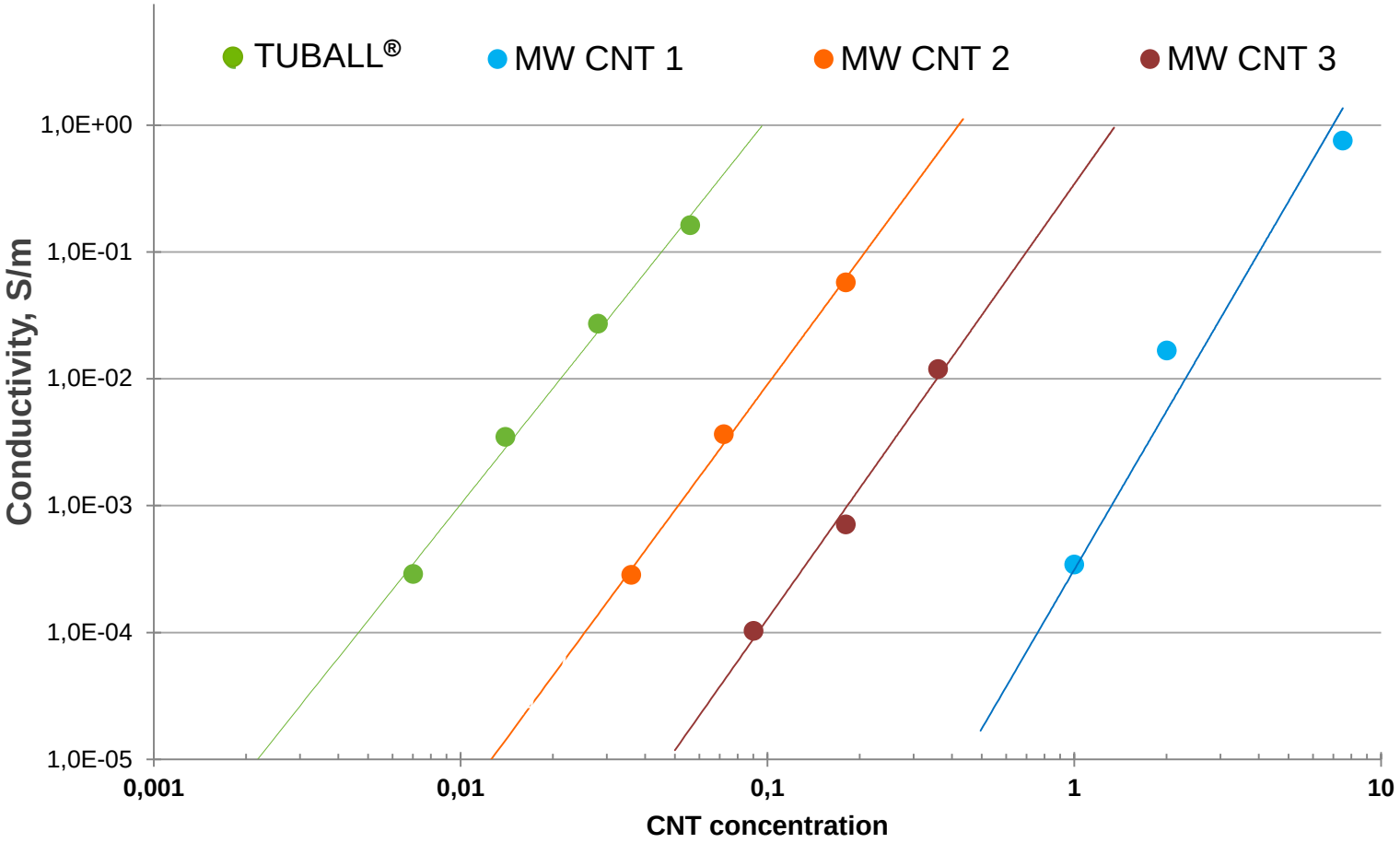
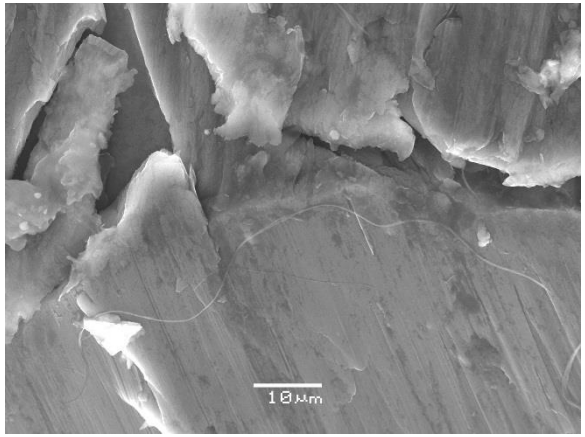
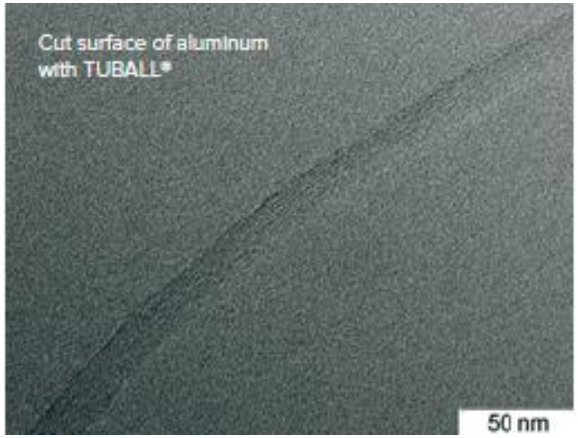
Electrical conductivity of Polyester Resin



COMPOSITES: CASTED ALUMINUM WITH TUBALL

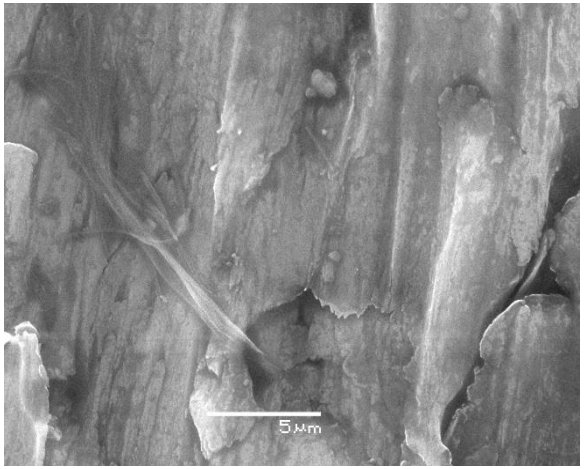
carbon nanomaterials for the global





"Nanomodified metals & metal alloys" LLC

Partner in development



	Strength MPa	
Tuball 0,03%	71,76	+89%
Tuball 0,12%	65,99	+74%
Tuball 0,3%	56,72	+49%
Base	37,99	

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Thank you for attention