Mobile Energy

SPECIALTY CARBONS FOR ADVANCED LEAD ACID BATTERIES

TIMREX®
Graphite

SUPER P®
Carbon Black

ENSACO®
Carbon Black


www.imerys-graphite-and-carbon.com

IMERYS
Graphite & Carbon
INNOVATIONS TO POWER EVERYDAY LIFE

Imerys Graphite & Carbon

A STRONG COMPANY

Imerys Graphite & Carbon, member of the Imerys Group, is the reference for innovative capability in the field of carbon-powder-based solutions: natural graphite and synthetic graphite powders, conductive carbon blacks, as well as silicon-carbon composites and water dispersions.
High standards in terms of employee health and safety, social behaviour and environmental responsibility are core values of the company, which is capturing opportunities by developing new products and applications, investing in assets & people, and growing its commercial presence worldwide.

500 Employees Worldwide

40 Countries

5 Industrial Sites

2 R&D Centers

Since 1908

FINANCIAL STRENGTH

Profitable company, part of Imerys, the world leader in mineral-based specialty solutions for industry, listed on the Paris stock exchange

IMERYS GROUP 2017

WORKFORCE	18,300
REVENUE	4.6 Bn
OPERATING MARGIN	14.1 %

RELIABLE PARTNER

INNOVATION STRATEGY
- Focused on the market and the Customer's needs

SECURITY OF SUPPLY
- 5 Industrial sites

OUR DRIVING FORCE
- Customer Service

RESPONSIBLE GROUP

COMMITMENT TO
- Green Technology and Sustainable Development

REDUCTION OF
- CO_2 Footprint

ENGAGEMENT WITH
- Local Communities

Carbon Additives in the Negative Electrode

FINAL BATTERY APPLICATIONS

- Automotive (micro HEV, e-bikes)
- Energy storage
- Industrial (fork-lifts, back-up systems, medical devices)

CARBON ADDITIVES REQUIREMENTS & BENEFITS

- Good wettability for paste processing and electrolyte supply to the negative electrode
- High affinity to lead for an efficient lead plating on the negative active mass (NAM) skeleton
- Good electrical conductivity to reduce electrode resistivity and represent active electrode component
- Sufficient BET specific surface area (SSA) and double layer capacitance for dynamic charge acceptance (capacitor effect)
- Sufficient purity to reduce gassing and self-discharge
- Balanced particle size distribution for homogeneous incorporation into electrode structure
- Improved cycle life
- Improved charge acceptance

In literature the following solutions are proposed:

- Low surface area carbon (graphite/expanded graphite mixed with low SSA carbon black)[a]
- High surface area carbon (graphite/expanded graphite mixed with high SSA carbon black)[b]

[a] D.P. Boden et al, J. Power Sources 195 (2010) 4470
[b] D. Pavlov et al, J. Power Sources 196 (2011) 5155

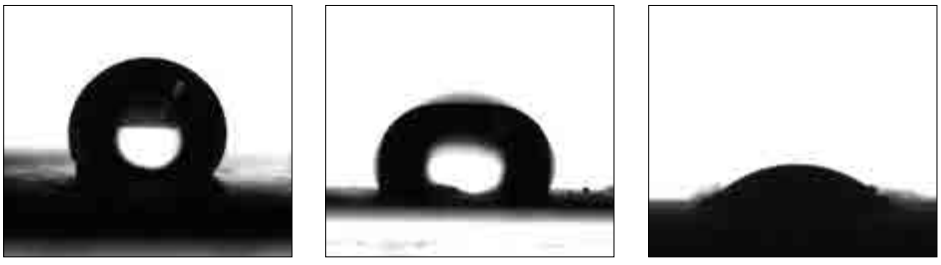
OUR SOLUTIONS

Imerys Graphite & Carbon offers the following specialty carbons solutions for advanced lead acid batteries:

PRODUCT	CONTACT ANGLE (WATER) (degree)	BET SURFACE AREA (m^2/g)	OIL ABSORPTION NUMBER (ml/100g)	SCOTT DENSITY (g/cm^3)	PARTICLE SIZE DISTRIBUTION
Carbon hybrid material					
TIMREX® CyPbrid™#	<30 (ultra-hydrophilic)	>180	<100	0.33	Micron-sized aggregates of sub-micron particles
Conductive carbon black					
SUPER P®	95 (mild-hydrophobic)	62	290	0.06	Agglomerated aggregates of nano-sized primary particles
ENSACO® 350G	130 (hydrophobic)	770	320	0.11	Agglomerated aggregates of nano-sized primary particles
Expanded graphite					
TIMREX® BNB90	<30 (ultra-hydrophilic)	28	180	0.03	Micron-sized particles

Table 1
Physio-chemical properties of different carbon materials

Typical values / #Patent pending



a) ENSACO® 350G b) SUPER P® c) TIMREX® CyPbrid™

Figure 1: Images from contact angle measurements on dry powder of different carbon additives with water.

The hydrophilic nature of TIMREX® CyPbrid™ is demonstrated. Consequently, TIMREX® CyPbrid™ is easily mixed into the active material paste. In addition, the electrolyte supply into the negative electrode plate is assured.

Carbon particles exhibiting a high affinity to lead, i.e. high spontaneous lead uptake, are well incorporated into the lead skeleton during formation of the negative active material.

Table 2
Electro-chemical data of Imerys Graphite & Carbon's materials

Typical values / #Patent pending

PRODUCT	SPONTANEOUS Pb-UPTAKE FROM $Pb(NO_3)_2$ SOLUTION (ppm)	SPECIFIC CAPACITANCE (F/g)
Carbon hybrid material		
TIMREX® CyPbrid™#	5823	20
Conductive carbon black		
SUPER P®	700	5
ENSACO® 350G	8660	70
Expanded graphite		
TIMREX® BNB90	1340	5

Figure 2: Electrical volume resistivity (2-point) for various carbon additives measured in dry powder form with increasing pressure increments of 50-450 kg/cm² at the corresponding sample density. TIMREX® CyPbrid™ shows an intermediate behavior between the TIMREX® synthetic graphite (high crystallinity; D90 = 6 micron) and ENSACO® 350G.

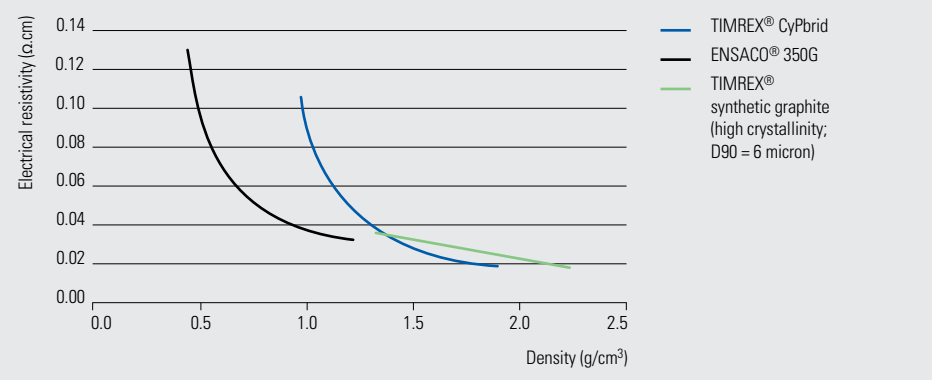
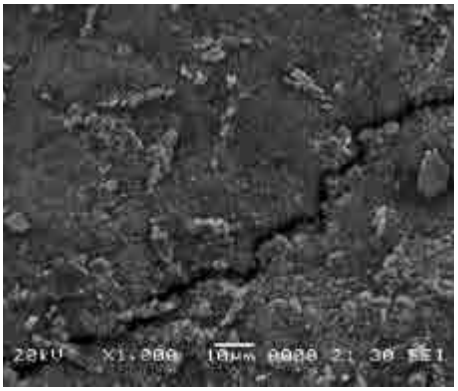
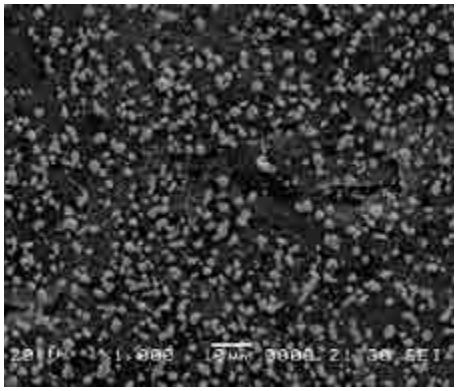


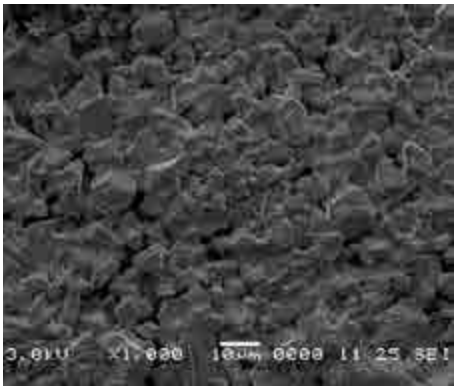
Figure 3: Scanning electron microscope (SEM) images on lead plating activity for different carbon additives: (a) ENSACO® 350G, (b) TIMREX® BNB90, (c) TIMREX® CyPbrid™, and (d) TIMREX® synthetic graphite (high crystallinity; D90 = 6 micron) The lead plating is induced by a potential pulse on a pure carbon electrode in a 1M $Pb(NO_3)_2$ solution. The SEM analysis indicates nucleation and growth of homogeneously distributed fine lead particles on the surface of the TIMREX® CyPbrid™ (photo c) and the TIMREX® BNB90 (photo b) electrodes.



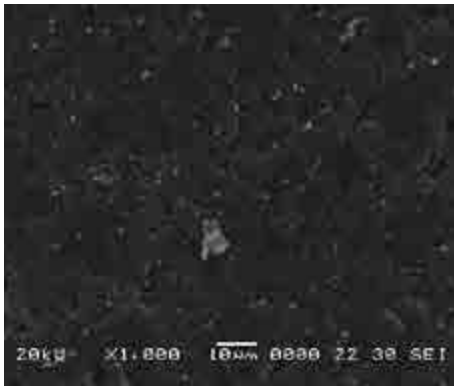
a) ENSACO® 350G



b) TIMREX® BNB90



c) TIMREX® CyPbrid™

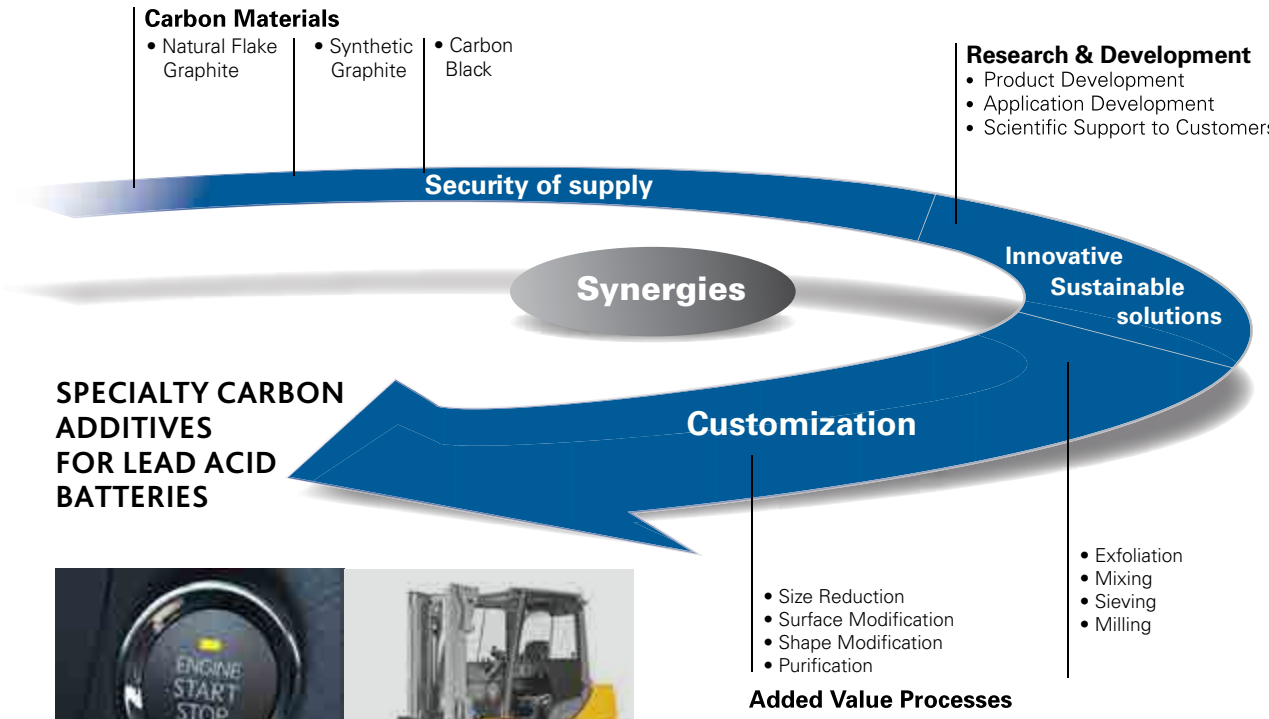


d) TIMREX® synthetic graphite (high crystallinity; D90 = 6 micron)

TIMREX® CYPBRID™

TIMREX® CyPbrid™ is the most suitable carbon additive for the negative electrode of an advanced lead acid battery, by combining the hybrid properties of a conductive carbon black and a graphite; resulting in excellent wettability for paste mixing, high affinity to lead for an efficient lead plating, and good electrical conductivity to improve cycle life and charge acceptance.

CARBON SOLUTIONS FOR LEAD ACID BATTERIES



SPECIALTY CARBON ADDITIVES FOR LEAD ACID BATTERIES

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