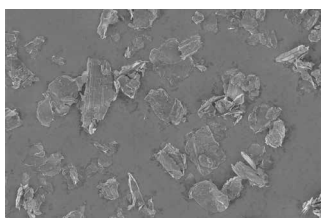




# SPECIALTY GRAPHITE FOR NEGATIVE ELECTRODES OF LITHIUM-ION BATTERIES

## C-ENERGY™ Graphite



SEM picture of C-ENERGY™  
KS15L Graphite

C-ENERGY™ L-SERIES is a specialty graphite range especially designed for negative electrodes of lithium-ion batteries.

### Key Features

- Enables the utilization of more economical active materials in the negative electrode
- Enables reduced additive dosage in the negative electrode
- Reduction of global additives cost (in negative and in positive electrodes)
- No additional pre-dispersing unit is required
- No need for a dispersing agent
- Faster electrolyte absorption
- Higher production outputs

| PRODUCT CHARACTERISTICS  | APPLICATION BENEFITS   |
|--|--|
| <b>Very High Purity</b> <ul style="list-style-type: none"> <li>• Ultra low metal impurities</li> <li>• Ultra low ionic impurities</li> </ul>   | <ul style="list-style-type: none"> <li>• Increased battery safety</li> <li>• Lower rejection rate</li> <li>• Fully compatible with most electrolyte systems</li> </ul>   |
| <b>Very High Electrical Conductivity and Reversible Capacity</b> <ul style="list-style-type: none"> <li>• Extremely high crystallinity</li> <li>• Very high electrical conductivity</li> <li>• Extremely high reversible capacity</li> </ul> | <ul style="list-style-type: none"> <li>• High energy density</li> <li>• Extremely high cycling stability</li> <li>• High charge acceptance</li> <li>• Lower dosage required vs conventional graphite grades</li> <li>• Reduced global additives costs</li> </ul>   |
| <b>High Density and Low Spring Back</b> <ul style="list-style-type: none"> <li>• High electrode density</li> <li>• High electrode compressibility</li> <li>• Significantly improved mechanical strength of the electrode</li> </ul>          | <ul style="list-style-type: none"> <li>• High energy density</li> <li>• High charge acceptance</li> <li>• Minimal electrode expansion after pressing</li> <li>• Improved electrode flexibility</li> <li>• Facilitates the addition of other conductive additives</li> </ul>  |
| <b>Very Efficient Electrolyte Wettability</b> <ul style="list-style-type: none"> <li>• Rapid electrolyte absorption</li> <li>• Very high electrical conductivity</li> <li>• Extremely high reversible capacity</li> </ul>                    | <ul style="list-style-type: none"> <li>• Cost reduction due to faster dispersion in water based electrode slurry</li> <li>• Cost reduction due to a faster electrolyte filling step in battery assembly</li> <li>• Improved battery performance due to more efficient anode wetting</li> <li>• Lower dosage required vs conventional graphite grades</li> <li>• Reduced global additive costs</li> </ul> |



[www.imerys-graphite-and-carbon.com](http://www.imerys-graphite-and-carbon.com)

## RECOMMENDED USE

The unique characteristics of C-ENERGY™ L-grades give unmatched performance improvement in Li-ion batteries.

**Recommended C-ENERGY™ L -grades dosage in negative active material: 2-8 wt%.**

C-ENERGY™ L-grades build a graphite matrix that facilitates the addition of other conductive additives.

Better performance is obtained when C-ENERGY™ L-grades are used in combination with ca. 1 wt% of C-ENERGY™ SUPER C65 or C-ENERGY™ SUPER C45 carbon black.

### Typical Product Properties

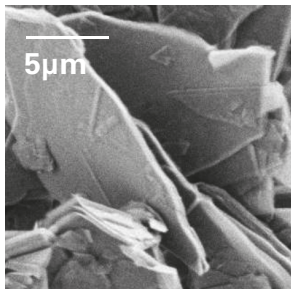
|        | Ash (%) | Fe (ppm) | Cl (ppm) | SO <sub>4</sub> <sup>2-</sup> (ppm) | AMOUNT OF MAGNETIC PARTICLES/ GRAM OF PRODUCT | TIME TO ADSORB DMC ELECTROLYTE SOLVENT (msec) <sup>1</sup> | TIME TO ADSORB WATER (msec) <sup>1</sup> | ELECTRODE DENSITY (g/cm <sup>3</sup> ) | SPRING-BACK (%) | REVERSIBLE CAPACITY (Ah/kg) |
|--------|---------|----------|----------|-------------------------------------|---|--|--|--|-----------------|-----------------------------|
| SFG15L | 0.01    | 10       | 5        | 25                                  | <1  | 100  | 300                                      | >1.75                                  | 10              | 370                         |
| SFG15  | 0.07    | 40       | 10       | 40                                  | 3   | 200  | 500                                      | >1.75                                  | 10              | 370                         |
| KS15L  | 0.01    | 10       | 5        | 25                                  | <1  | 200  | 400                                      | >1.75                                  | 13              | 355                         |

More data available upon request

<sup>1</sup> Defined as time it takes to reach a contact angle of 0°

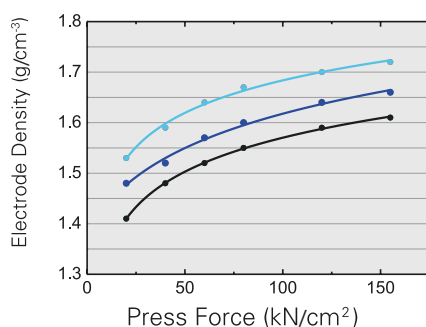
## GRAPHITE ADDITIVES IN THE NEGATIVE ELECTRODES

### C-ENERGY™ Graphite



SEM picture of C-ENERGY™ KS15L Graphite

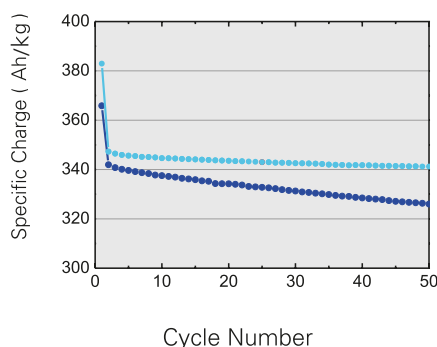
Density of C-ENERGY™ ACTILION 1 electrodes containing C-ENERGY™ SFG 15L



● 2 % SFG 15L  
● 5 % SFG 15L  
● 8 % SFG 15L

Binder material: 1.5 wt.% SBR/1.5 wt.% CMC

Influence of C-ENERGY™ SFG 15L on the cycling stability of C-ENERGY™ ACTILION 1 electrodes



● 0 % SFG 15 L  
● 10 % SFG 15 L

Lithium half-cells, 1C/3D (CCCV)

Binder material:

1.5 wt.% SBR/1.5 wt.% CMC

Electrode density: 1.7 g cm<sup>-3</sup>

Electrolyte: 1 M LiPF<sub>6</sub> in EC/EMC 1:3 (w/w)