



**Ceylon Graphene Technologies**

# **Product Data Sheet**

## **Expanded Graphite (EG)**

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## Equipment's used

XPS	: Thermo Scientific™ ESCALAB™ Xi+ X-ray Photoelectron Spectrometer
SEM	: HITACHI SU6600, Variable pressure FE-SEM
BET	: Quantachrome Instruments, Autosorb iQ Station 2- automated gas sorption analyzer
RAMAN	: BRUKER SENTERRA II -Confocal Raman Microscope
FTIR	: Bruker VERTEX 80 Fourier Transform Infrared Spectrometer
PSA	: FRITSCH Analysette 22 Micro Tec plus Particle Size Analyzer
TGA	: TA Instruments- SDTQ600 Thermo Gravimetric Analyser

## Sample Details

Start-up Graphite	: Sri Lanka - C99+ Vein Graphite, Piratical size range: 63-90 $\mu\text{m}$
Appearance	: Soft Black Powder Platelets
Tapped Density	: ~0.047 g/cm <sup>3</sup>

## Analysis and Results

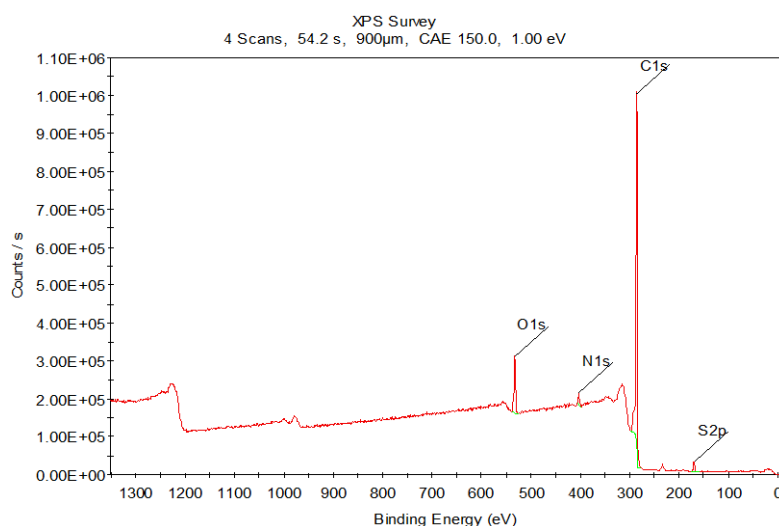
### X-ray Photoelectron Spectroscopy (XPS)

The sample was mounted on a glass substrate using double tape. Three different spots per sample were analyzed. Parameters were set as follows, X-Ray source: Monochromatic Al K $\alpha$  (1486.6 eV), Spot size: 900  $\mu\text{m}$ . Survey scans and high resolution scans were collected with pass energies of 150 and 20 eV and with a step size of 1.0 and 0.05 eV. Detailed spectra processing was performed by Thermo Avantage (5.982) software

### Results

Name	Peak BE	Atomic %			Avg. %
		scan 1	scan 2	scan 3	
C1s	284.82	89.63	90.56	89.11	89.77
O1s	530.49	6.37	6.31	6.85	6.51
N1s	400.33	2.28	1.74	2.35	2.12
S2p	167.46	1.73	1.38	1.69	1.60

\*C/O ratio: 13.79



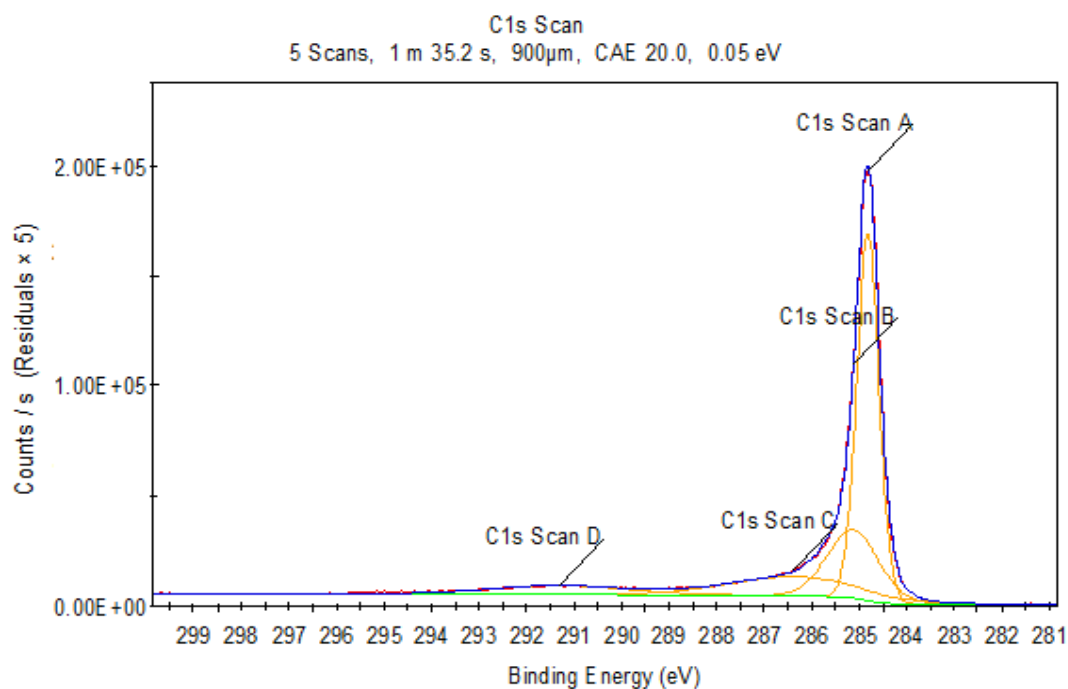


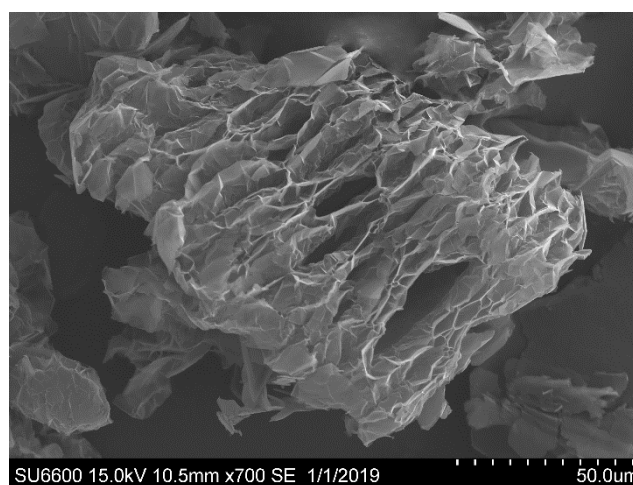
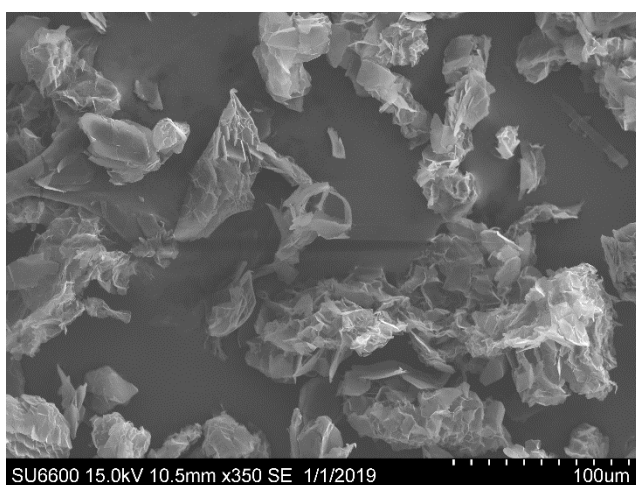
Figure 2: XPS narrow scan for expanded graphite

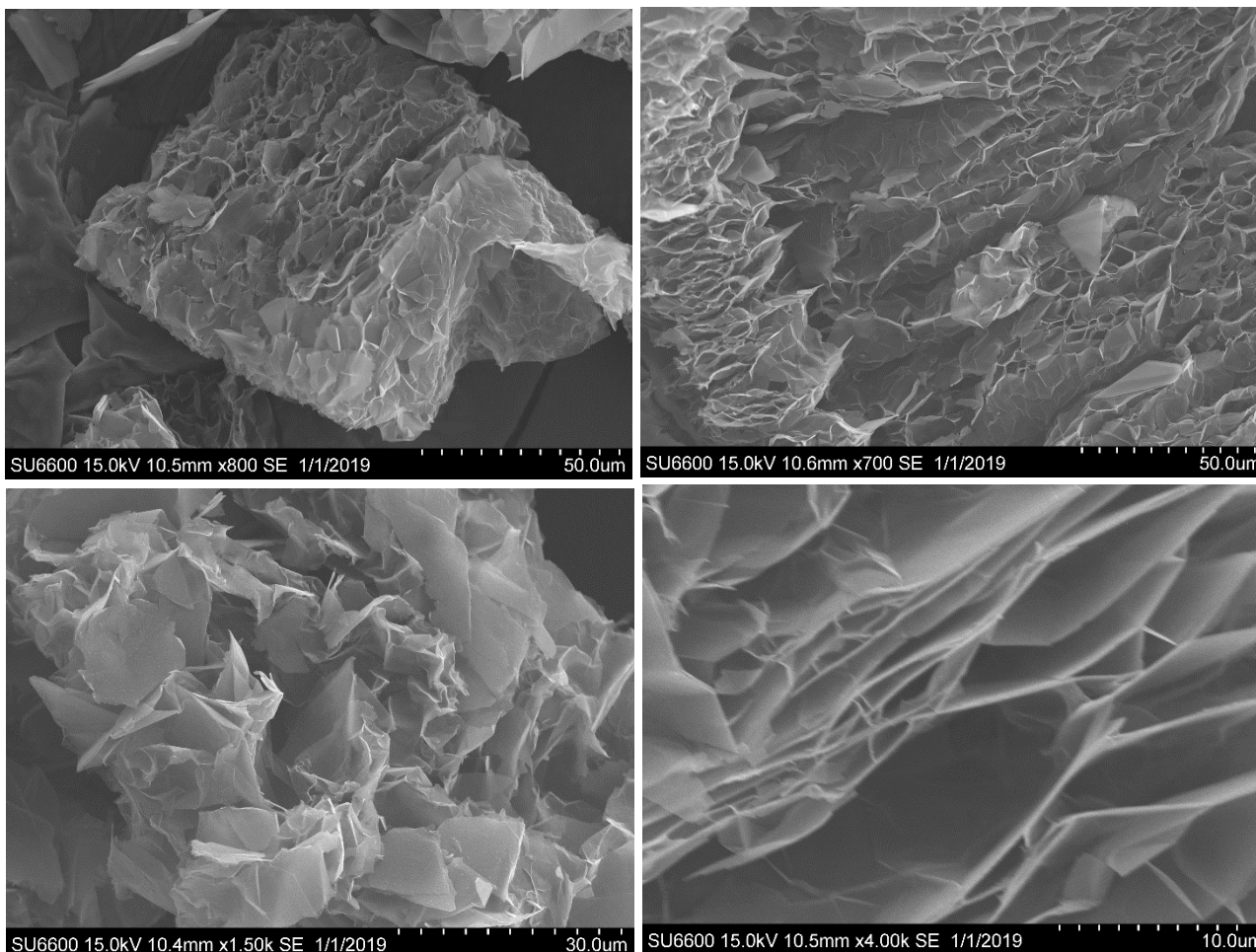
### Peak Table for XPS narrow scan

Name	Bond type	Peak BE	Atomic %
<i>C1s Scan A</i>	sp <sup>2</sup> carbon	284.82	52.72
<i>C1s Scan B</i>	sp <sup>3</sup> carbons	285.12	22.87
<i>C1s Scan C</i>	epoxy	286.37	16.38
<i>C1s Scan D</i>	carboxyl	291.32	8.03

### Scanning electron microscope (SEM)

The sample was drop casted on the Al sample stage and different spots were analyzed.





### BET Surface Area Analysis

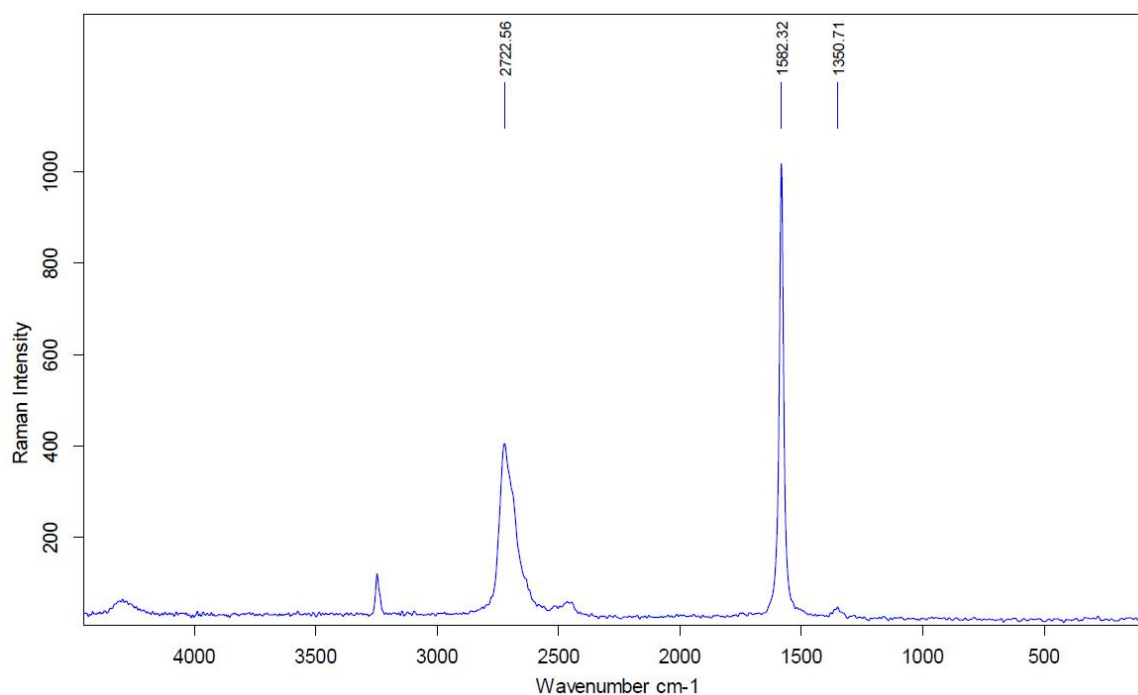
The sample was analyzed for Multi-Point BET Surface Area and BJH pore size distributions. Parameters were set as follows, Approx. Outgas Time: 3.6 hrs., Final Outgas Temp.: 200 °C, Analysis gas: Nitrogen, Cell Type: 9mm, Bath temp.: 77.35 K

Sample	BET Surface Area (m <sup>2</sup> /g)	BJH Surface Area (m <sup>2</sup> /g)	Pore Volume (cc/g)	Pore Diameter (nm)
Expanded Graphite	8.375	10.521	0.057	3.931



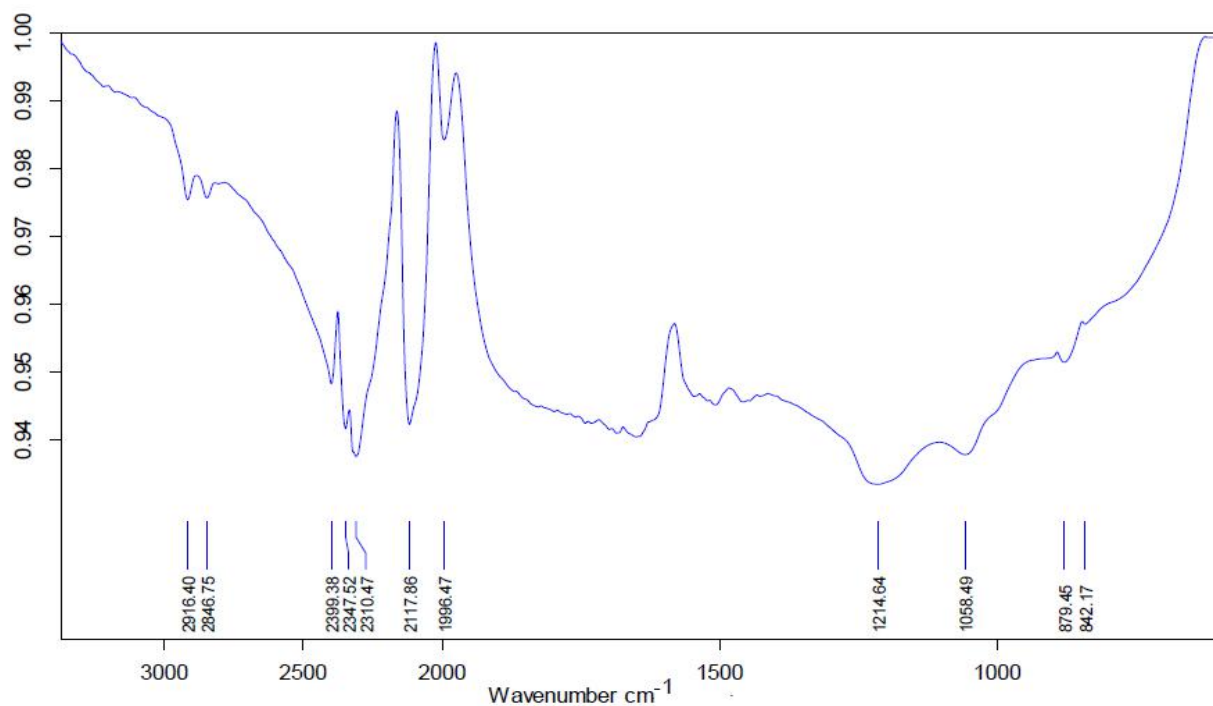
## RAMAN Analysis

The sample was drop casted on the microscopic glass slides. Three different spots were analyzed.



Parameters were set as follows. 514 nm, green laser was used with 20X optical zooming.

## FTIR Analysis

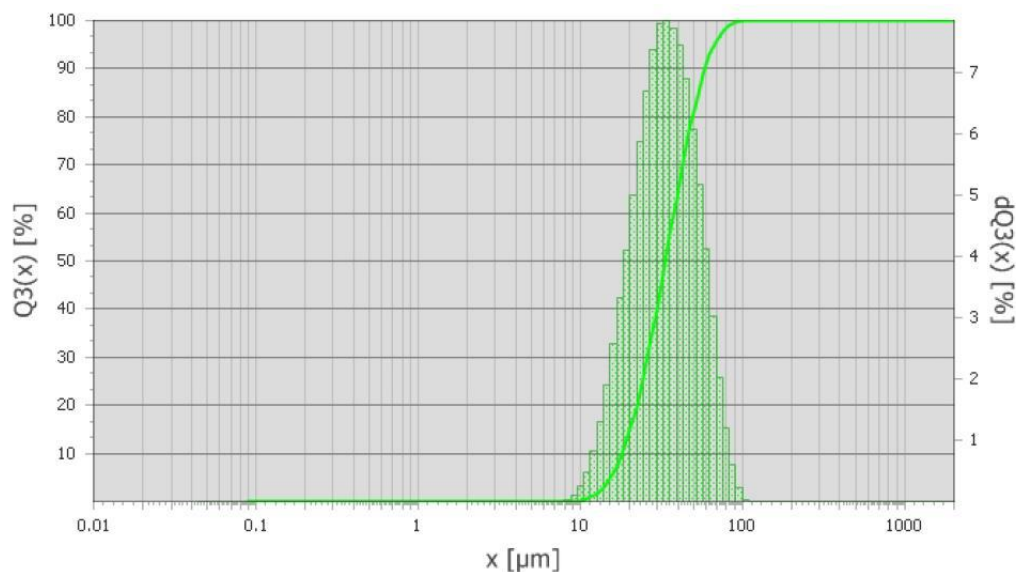


Attenuated total reflection Fourier transform infrared (ATR-FTIR) spectra of the expanded graphite powder were recorded in the region 3500–600 cm<sup>-1</sup> at a resolution of 4 cm<sup>-1</sup>



## Particle Size Analysis

Analysis was performed in the range of 0.08  $\mu\text{m}$  to 2000  $\mu\text{m}$  with beam obscuration of 15.0%. Three sample were analyzed in order to obtain an average value.



Cumulative frequency, Q3(x) [%]	Avg. Particle Size(x), [ $\mu\text{m}$ ]	Particle Size [ $\mu\text{m}$ ]		
		Analysis 1	Analysis 2	Analysis 3
10	18.0	18.1	17.9	18.1
50	33.1	33.5	32.9	32.8
90	57.8	58.8	57.6	57.0

## TGA Analysis

Analysis was performed in Nitrogen environment of the flow rate of 100 ml/min, in the temperature range of 25  $^{\circ}\text{C}$  to 1200  $^{\circ}\text{C}$  with ramp rate of 10  $^{\circ}\text{C}/\text{min}$ .