KERONE
Kerone Engineering Solutions Limited

CONTINUOUS MICROWAVE DRYER **FOR THE GRAPHENE EXFOLIATION SYSTEM**

In Association with SVCH-Technologii, Moscow (Russia)

ISO 9001:2015 | ISO 14001:2015 | ISO 45001:2018

ABOUT US

KERONE is now renowned for serving the specialized needs of customers with the best quality and economical process of Heating /cooling and drying products, manufactured in a high-quality environment by a trained and qualified workforce (special purpose machinery)

KERONE is a pioneer in application and implementation engineering with its vast experience and team of professionals.

KERONE is devoteded to serve the industry to optimize its operations both economically and environmentally with its specialized heating and drying solutions.

KERONE is having immense expertise in manufacturing and implementing various types of engineering solutions.

KERONE is possessing employee strength of more than 280+ experts continuously putting efforts for happy industrial engineering solutions.

WHY CHOOSE US

> Enhance the value of customer operation through our customer need centric engineering solution.

With decades of expertise, cutting-edge technology, and a customer-centric approach, Kerone Engineering offers tailor-made heating solutions that prioritize quality, flexibility, and cost-effectiveness. Benefit from our commitment to excellence, post-sales support, and innovative solutions for your unique heating needs. Choose Kerone Engineering for reliability, performance, and unmatched value.

MISSION

- To enhance the value of customer operation throughi our customer need centricengineefing solution
- We are cominitted to provide our customers, unique arid best in class products in Industrial heating drying and cooling segment with strategic tie-up for the technical know-how with renowned leader in the industry specific segment

VISION

- Turn into a world leader in providing specialized, top-notch quality and ecological industrial heating, cooling, and drying solutions across the globe.
- To attain global recognition as the best of quality and environment-friendly engineering solution company.

Description

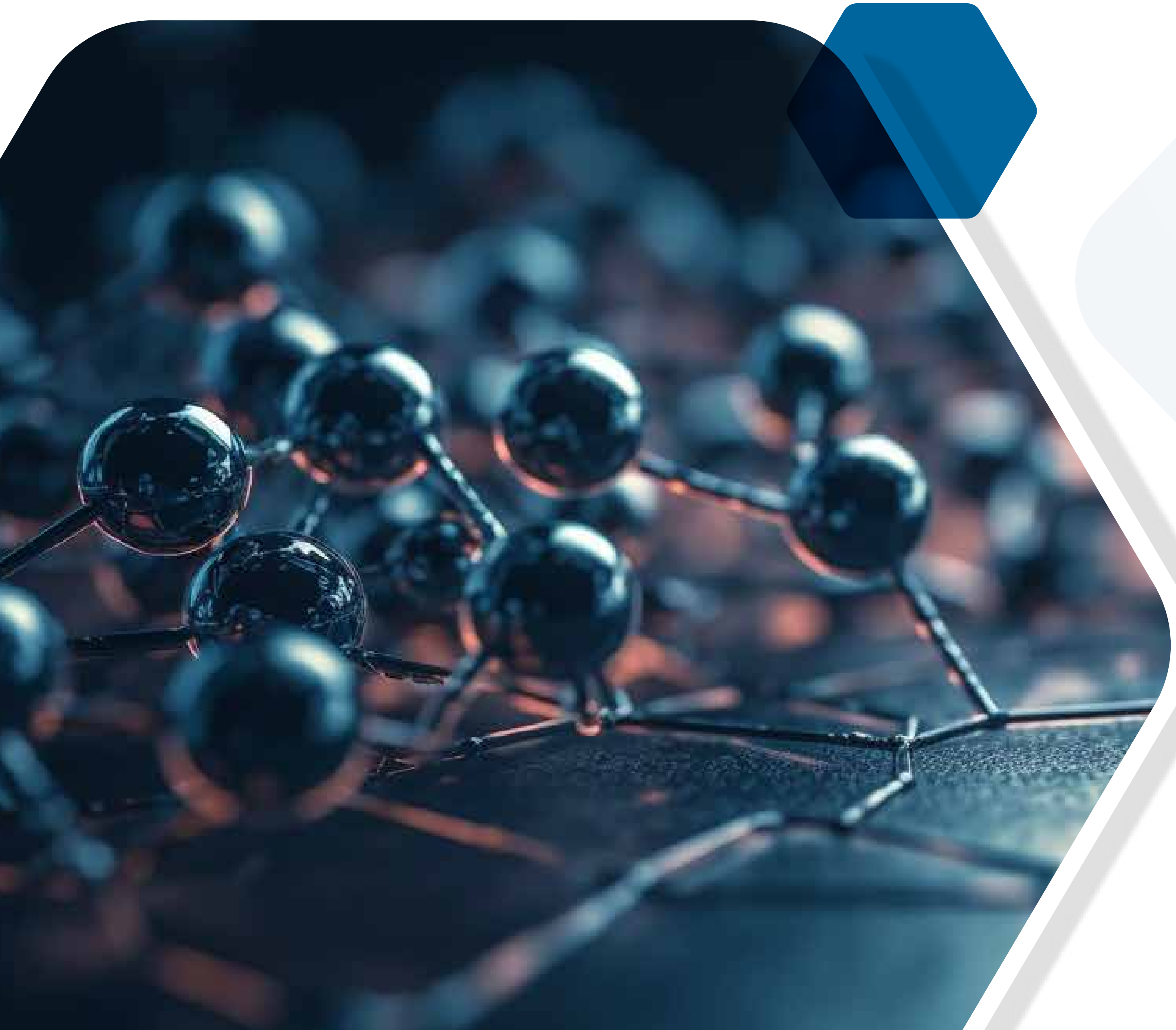
It takes the advantages of strong wave-absorbing characteristic of graphite and intercalations. The intercalations reacts fiercely under high density microwave power reaching a instantaneous temperature at 2000 ºC and gasified, meanwhile the graphite expanded 300 to 500 times into high quality few layers (3 to 10 layers) graphene in 10~20 seconds.

Advantages

- The first continuous microwave graphene exfoliation equipment. Produce few layers graphene from intercalated graphite in seconds.
- Satisfying the future mass production requirement, can achieve 200kgs/hour graphene output.
- Water-Cooled magnetrons and High end industrial microwave frequency variable power supply can achieve a 24hours/ day continuous production.
- Advanced design and assemble to ensure meet the standard microwave leakage regulations, environmental regulations and eclectic system protection.
- Stainless-steel body and imported conveyors to ensure a reliable operation.

Features

- Take the advantages of microwaves selective and concentrative to graphene molecule that is high dielectric constant, thus maximize the production efficiency and quality.
- The whole production processes it less than 90 seconds, meanwhile can achieve the desulfurization, therefore to enable the high purity graphene and less rear end purification process.



What is Graphene?

Graphene is an allotrope of carbon consisting of a single layer of atoms arranged in a hexagonal lattice nanostructure. The name is derived from "graphite", reflecting the fact that the graphite allotrope of carbon contains numerous double bonds.

Graphene has become a valuable and useful nanomaterial due to its exceptionally high tensile strength, electrical conductivity, transparency, and being the thinnest two-dimensional material in the world. The global market for graphene was $9 million in 2012, with most of the demand from research and development in semiconductor, electronics, electric batteries, and composites. The IUPAC (International Union for Pure and Applied Chemistry) recommends use of the name "graphite" for the three-dimensional material, and "graphene" only when the reactions, structural relations, or other properties of individual layers are discussed. A narrower definition, of "isolated or free-standing graphene" requires that the layer be sufficiently isolated from its environment, but would include layers suspended or transferred to silicon dioxide or silicon carbide.

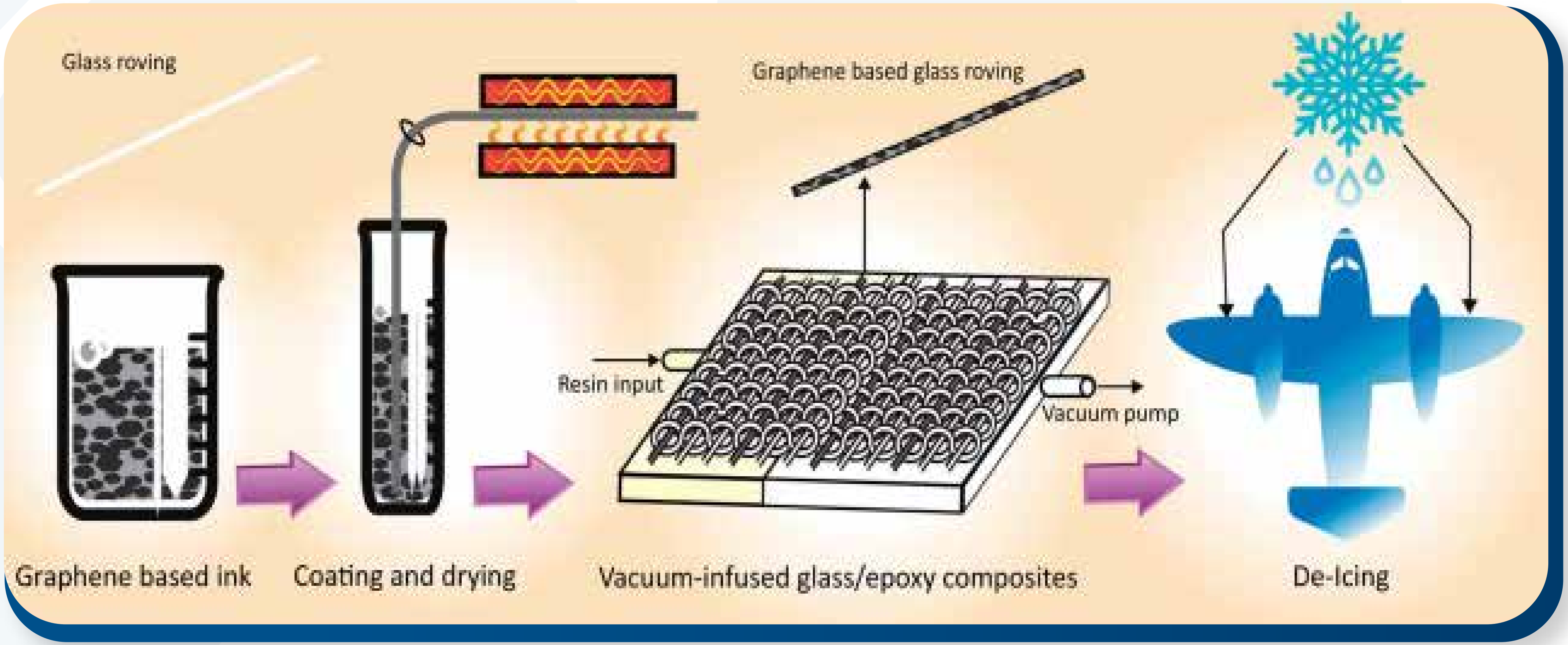
What is Graphene Exfoliation System?

- Liquid-phase exfoliation of graphite oxide is the most widely used method for the preparation of graphene. In this method, the graphite is intercalated with strong oxidizing agents [53,54,56], followed by graphite layers' expansion via sonication. The reduction of the obtained graphene oxide to graphene is usually conducted by either thermal or chemical approaches

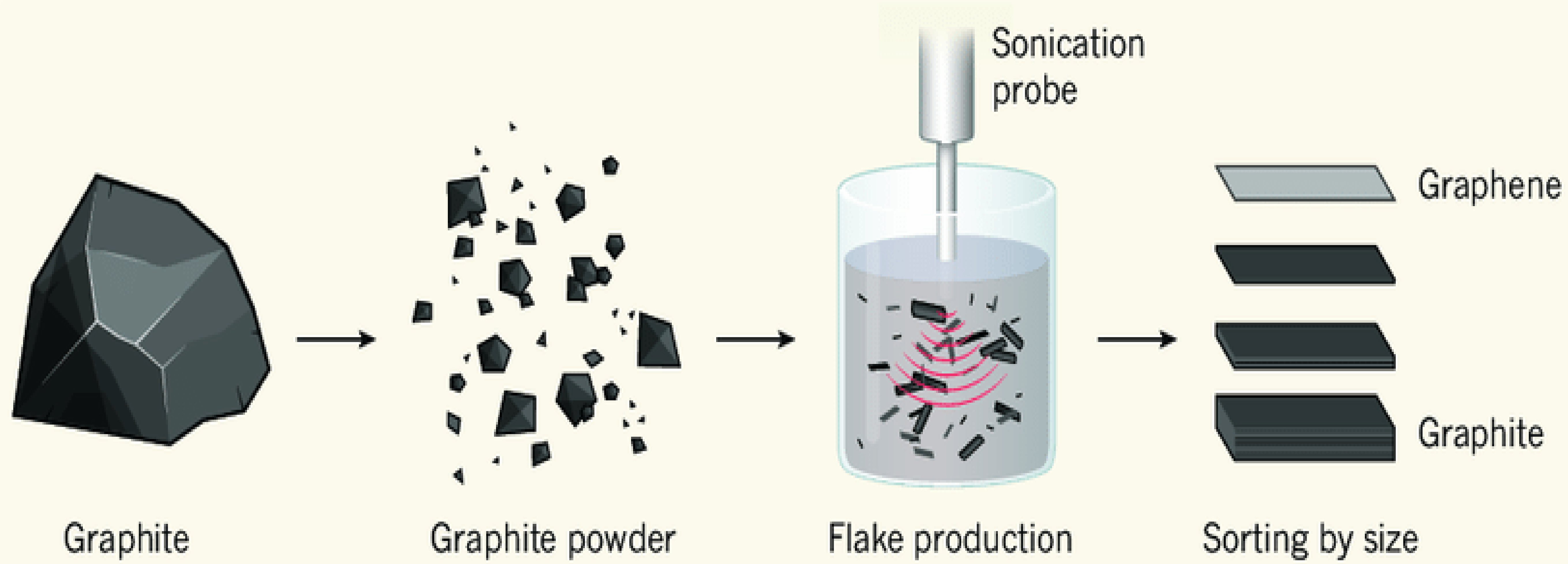
Uses And Application of Graphene

The scientific community is keeping its eyes on graphene, as it could completely change the way we relate to technology. And not just that, it could also represent significant advances in different sectors.

- Graphene in electronics
- Graphene in health
- Graphene in construction
- Graphene in energy sector



Origination of Graphene



Structure of graphite and its intercalation compounds

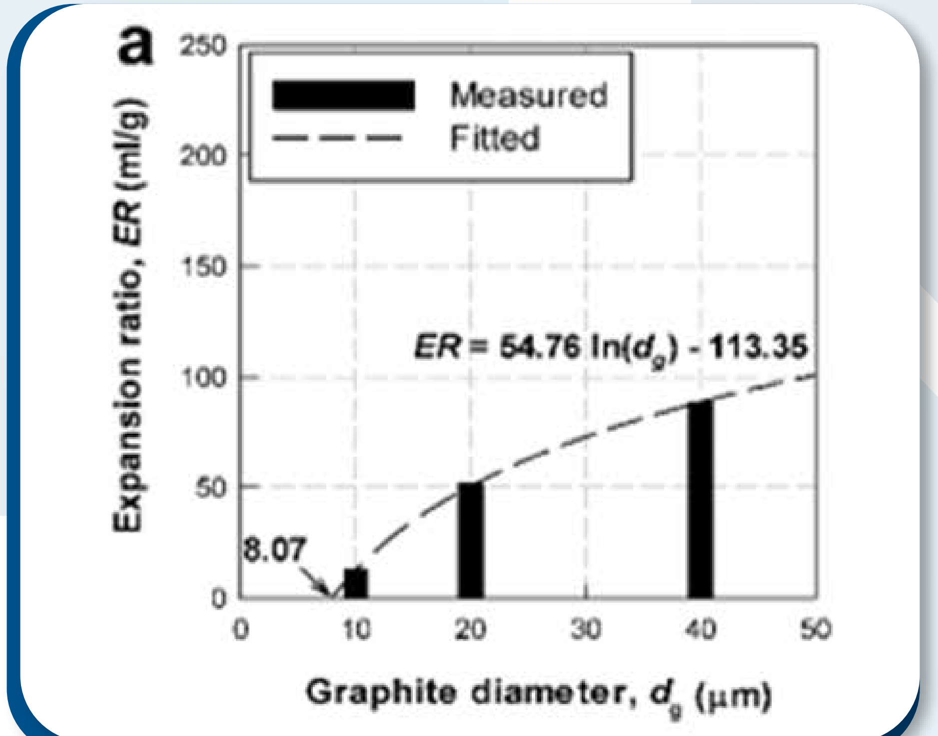
In 1859, Benjamin Brodie noted the highly lamellar structure of thermally reduced graphite oxide. In 1916, Peter Debye and Paul Scherer determined the structure of graphite by powder X-ray diffraction. The structure was studied in more detail by V. Kohlschütter and P. Haenni in 1918, who also described the properties of graphite oxide paper. Its structure was determined from single-crystal diffraction in 1924.

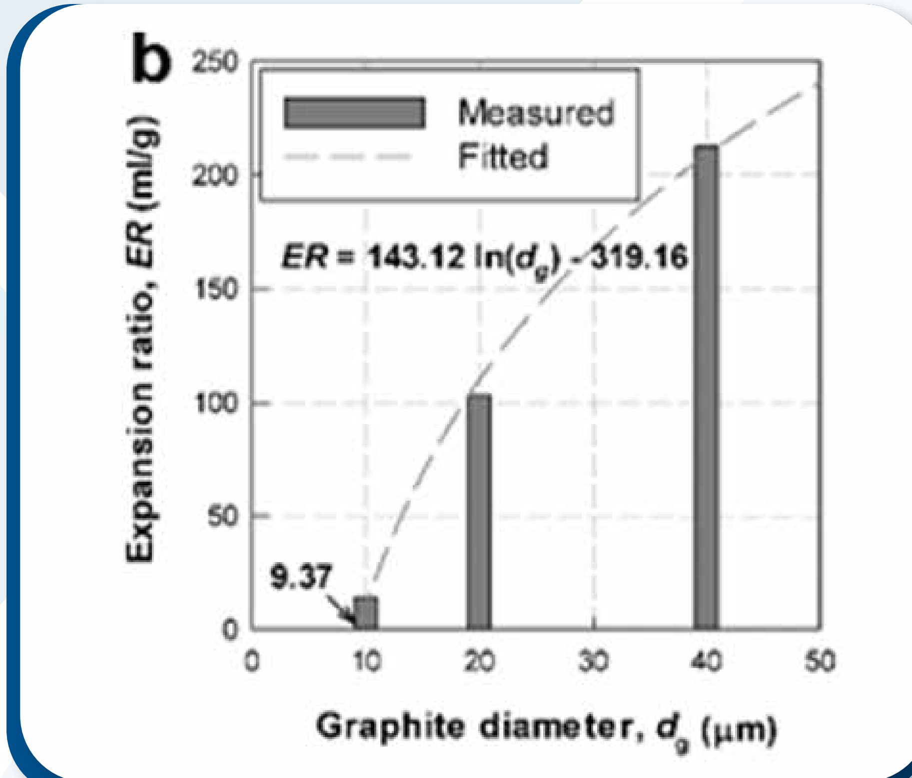
The theory of graphene was first explored by P. R. Wallace in 1947 as a starting point for understanding the electronic properties of 3D graphite. The emergent massless Dirac equation was first pointed out in 1984 separately by Gordon Walter Semenoff, and by David P. DiVincenzo and Eugene J. Mele. Semenoff emphasized the occurrence in a magnetic field of an electronic Landau level precisely at the Dirac point. This level is responsible for the anomalous integer quantum Hall effect.

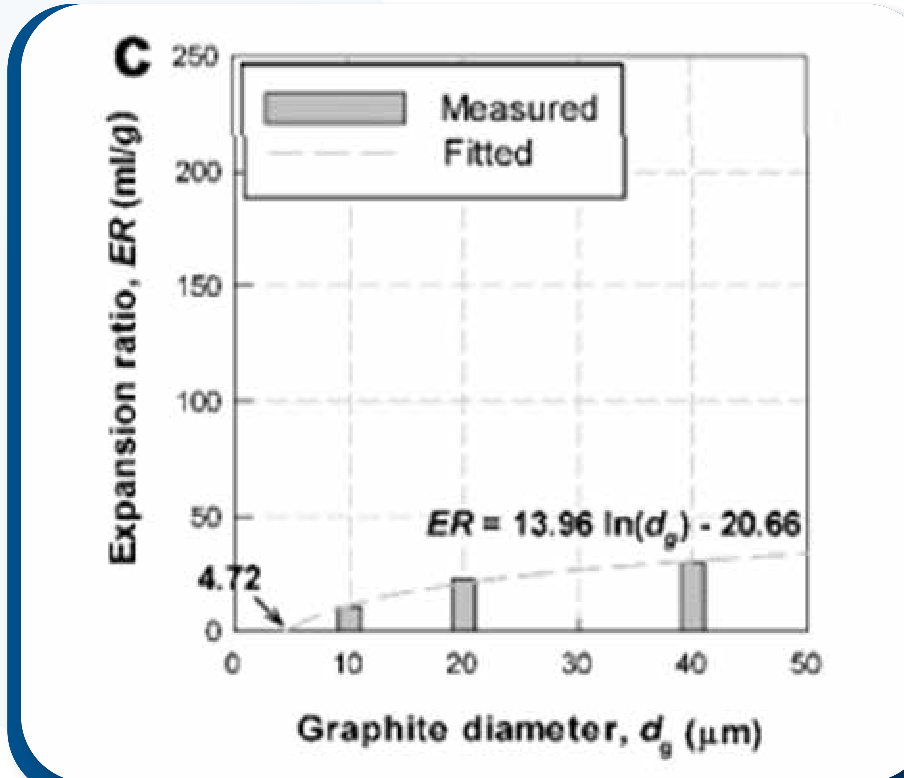
Graphite Form

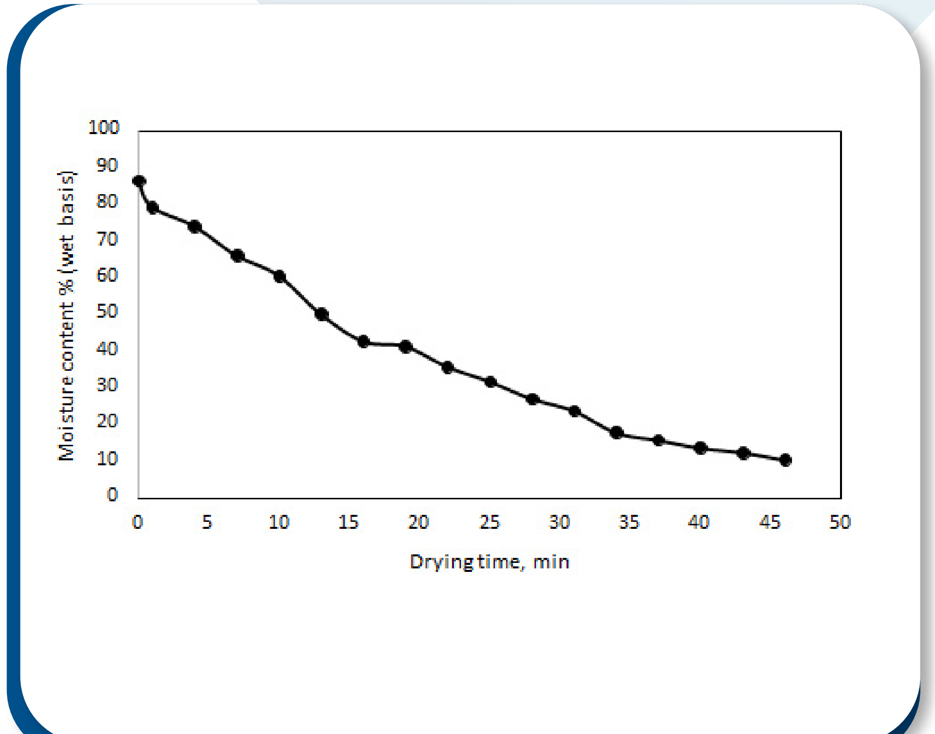
We characterized the dependence of ER on the form (natural vs. synthetic), type (lump vs. flake), and size (10 to 40 μm in diameter) of graphite. The expansion capacity of graphite in the microwave-assisted exfoliation was specific to certain forms and types of graphite and differences in particle size: natural graphite achieved about 4.3 times larger ER than synthetic one; flake-type graphite showed about 2.4 times larger expansion capacity than lumptype one; large graphite had higher ER than small one. The first phenomenon related to graphite form can be explained by the physical fact that natural graphite exhibits a much higher crystalline structure than synthetic one; the second is because flake-type graphite has more open areas (or spaces) for intercalation and exfoliation than lump-type one with the highest degree of cohesive integrity. The last but not least phenomenon can be understood by constructing a fluiddynamics-based model. The main assumption of this model is that the expansion of graphite by microwave irradiation is due to the pressure exerted by an accumulating gas from the expansion of intercalation agent. Thus, we model the exfoliation of graphite as a steady, laminar flow occurred in the space between two fixed parallel and circular plates

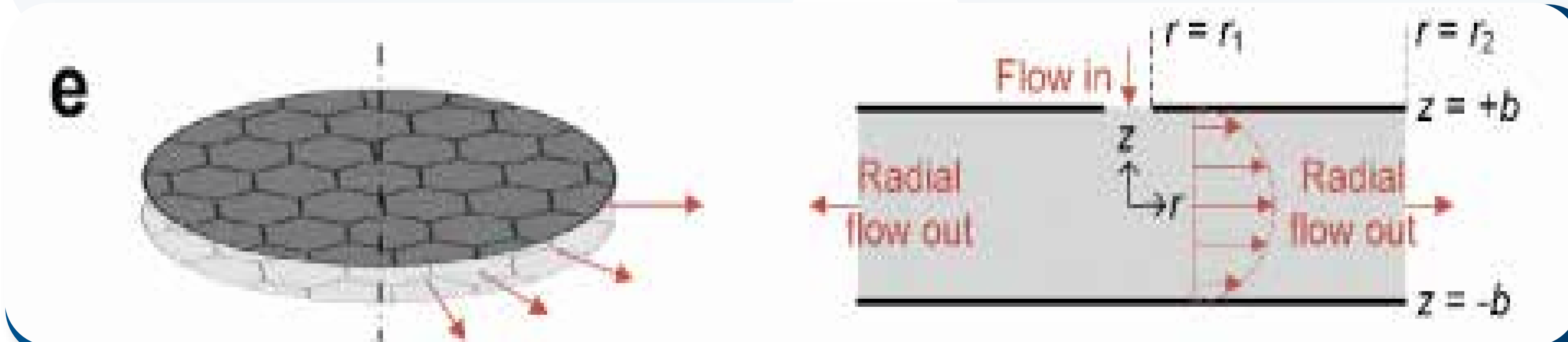
$$ER \sim R_f = \frac{3\mu \ln\left(r_2 / r_1\right)}{4\pi b^3 \rho} = C_1 \ln r_2 + C_2,$$

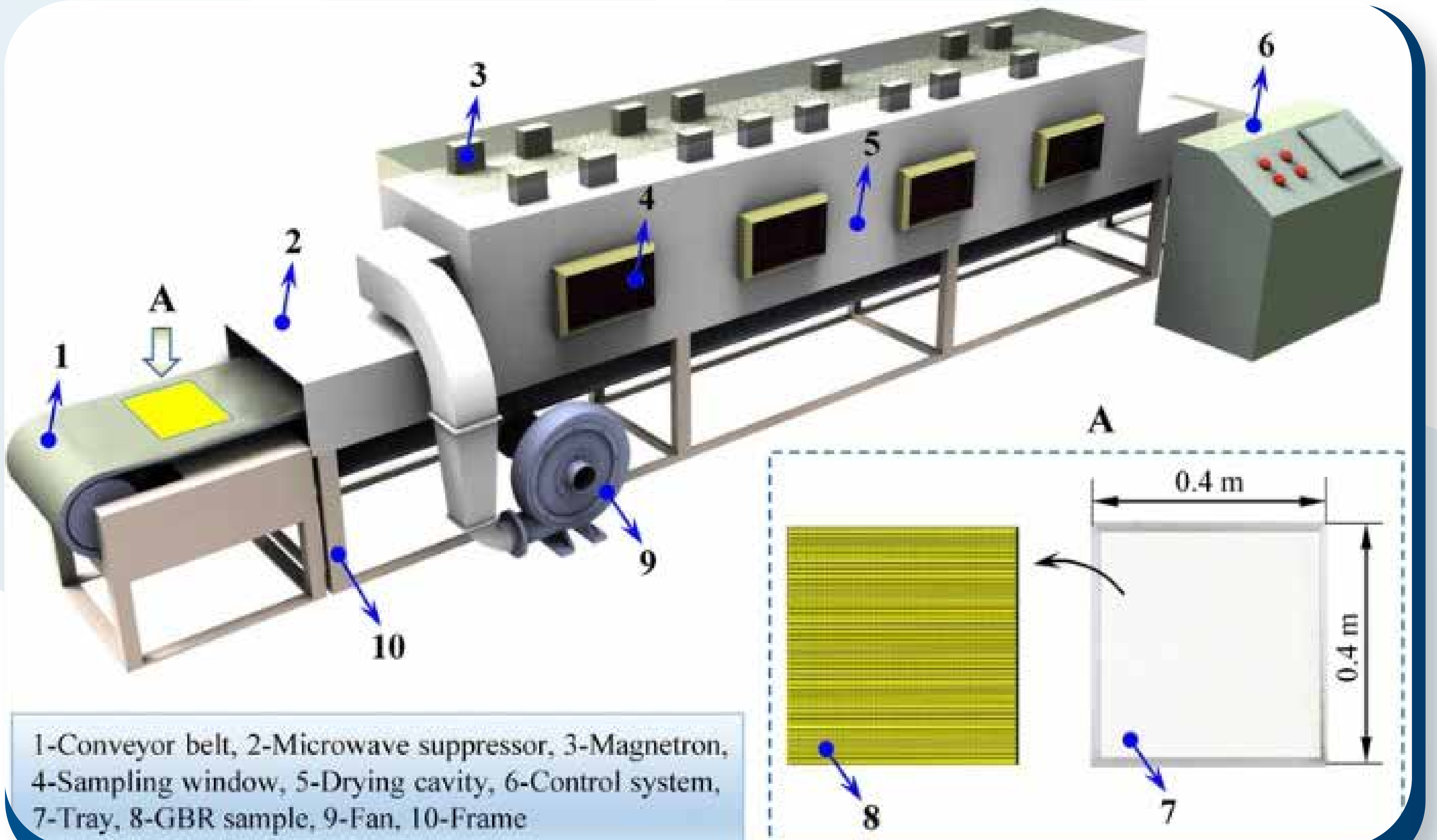

a
Measured
Fitted
ER = 54.76 ln(d_g) - 113.35
8.07
Expansion ratio, ER (ml/g)
Graphite diameter, d_g (μm)
0
50
100
150
200
250
0
10
20
30
40
50


b
Measured
Fitted
ER = 143.12 ln(d_g) - 319.16
9.37
Expansion ratio, ER (ml/g)
Graphite diameter, d_g (μm)
0
50
100
150
200
250
0
10
20
30
40
50


c
Measured
Fitted
ER = 13.96 ln(d_g) - 20.66
4.72
Expansion ratio, ER (ml/g)
Graphite diameter, d_g (μm)
0
50
100
150
200
250
0
10
20
30
40
50


Moisture content % (wet basis)
Drying time, min
0
10
20
30
40
50
60
70
80
90
100
0
5
10
15
20
25
30
35
40
45
50


e
Flow in
r = r1
r = r2
z = +b
z = -b
z
r
Radial flow out
Radial flow out


1
A
2
3
4
5
6
9
10
A
0.4 m
0.4 m
8
7
1-Conveyor belt, 2-Microwave suppressor, 3-Magnetron,
4-Sampling window, 5-Drying cavity, 6-Control system,
7-Tray, 8-GBR sample, 9-Fan, 10-Frame

TRUSTED PARTNERS

AFCONS

Technip

TÜV
ISO 14001:2004

TOYO ENGINEERING

EIL

LLOYD'S

ZEPPELIN
WE CREATE SOLUTIONS

Reliance Engineering Associates Pvt. Ltd.

TATA
TATA CONSULTING ENGINEERS LIMITED

SC Shroff Consultants

STERLING & WILSON

THANK YOU

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