5th HVM New Materials 2019, 6-7 November Cambridge, UK

www.cir-strategy.com/events

WILLIAM BLYTHE LTD,

ADVANCED MATERIALS

www.williamblythe.com

synthomer

Synthomer

£1.61Bn
group revenue

Top 5
supplier of emulsion and specialty polymers

18
countries

FTSE
FTSE250
listed company

2900
employees

25
production sites

3
Business Divisions

1 *Functional Solutions*

- Adhesives
- Coatings
- Construction
- Textile

2 *Performance Elastomers*

- Paper, Carpet & Compounds, Foam
- Health and Protection

3 *Industrial Specialities*

- Coalescing agents
- Monomers
- Powder Coatings
- Performance Polymers
- Inorganic Materials

Inorganic Materials: William Blythe Ltd

1845
William Blythe founds the company in Church, Lancashire to produce chemicals for the textile industry

1854
First William Blythe patent filed on a novel process for manufacturing sulfuric acid

1892
William Blythe & Co. Limited was established, with William Blythe's sons as directors

1919
William Blythe acquires the chemical business of John Riley and Sons, a manufacturer of metal salts and acids

1928
William Blythe becomes a public company

1950s
Growth of the business producing sulfuric and hydrochloric acid and sulfate salts

1969
William Blythe acquired by Hickson and Walsh to produce arsenic salts for wood preservation

1989
Development of Flamtard zinc and tin based flame retardant products with Alcan

1990
William Blythe acquired by Holliday Chemicals Holdings (HCH). Significant investment in new process and plant

1994
New copper carbonate plant

1998
William Blythe becomes a wholly owned subsidiary of Synthomer after the Synthomer acquisition of HCH

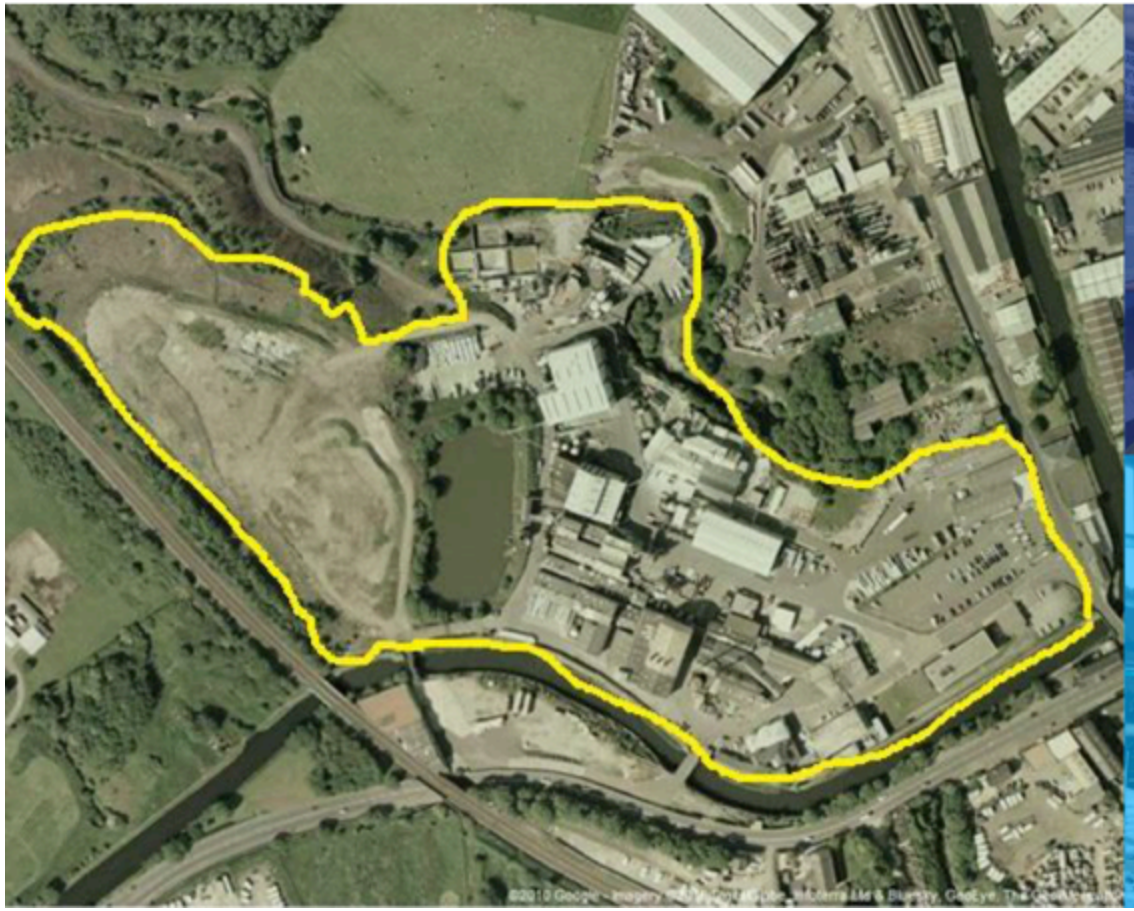
2000s
Development of copper zinc carbonate, periodic acid, stannous chloride and sodium stannate products and processes

2010s
New analytical R&D facility and multipurpose production facilities opened as the company moves to advanced materials manufacture, e.g. graphene oxide

2018
Hydrothermal plant opened to manufacture tungsten oxides

William Blythe Ltd

William Blythe Ltd: Manufacture of Specialty Inorganic Chemicals



How We Work

- R&D projects with customers to solve their problems
- Product development and continuous improvement
- Grant-funded R&D to explore new areas

Collaboration

UKRI Innovate UK

oxis ENERGY

Echion Technologies

ceetak sealing solutions

UCL

QINETIQ

WMG THE UNIVERSITY OF WARWICK

agm batteries

cpi

UNIVERSITY OF BIRMINGHAM

DELTA MOTORSPORT

G2O WATER TECHNOLOGIES

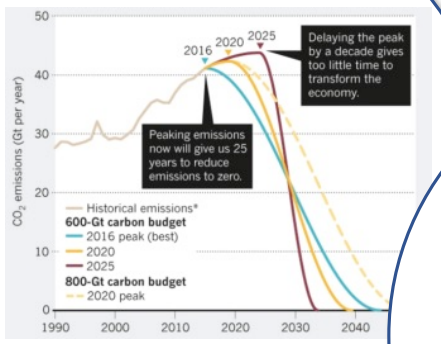
Unilever

WILLIAMS ADVANCED ENGINEERING

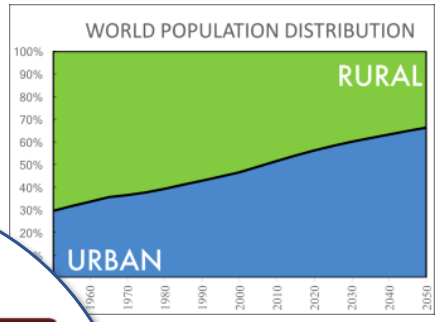
synthomer

William Blythe Ltd Materials Applications

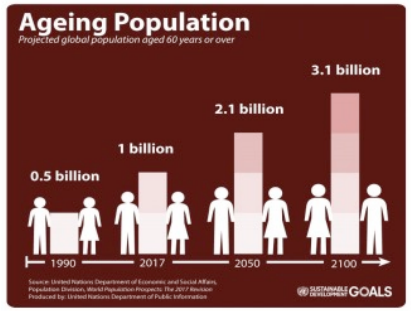
Environment



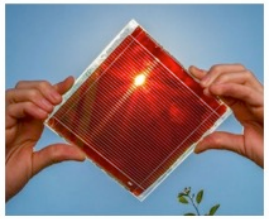
Urbanisation



Ageing Population



Environment

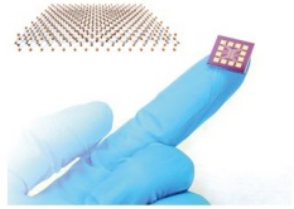


- Energy efficiency
- Energy harvesting
- Energy storage
- Materials efficiency
- Gas and water cleaning

Safety

- Flame retardant synergist polymer additives

Health



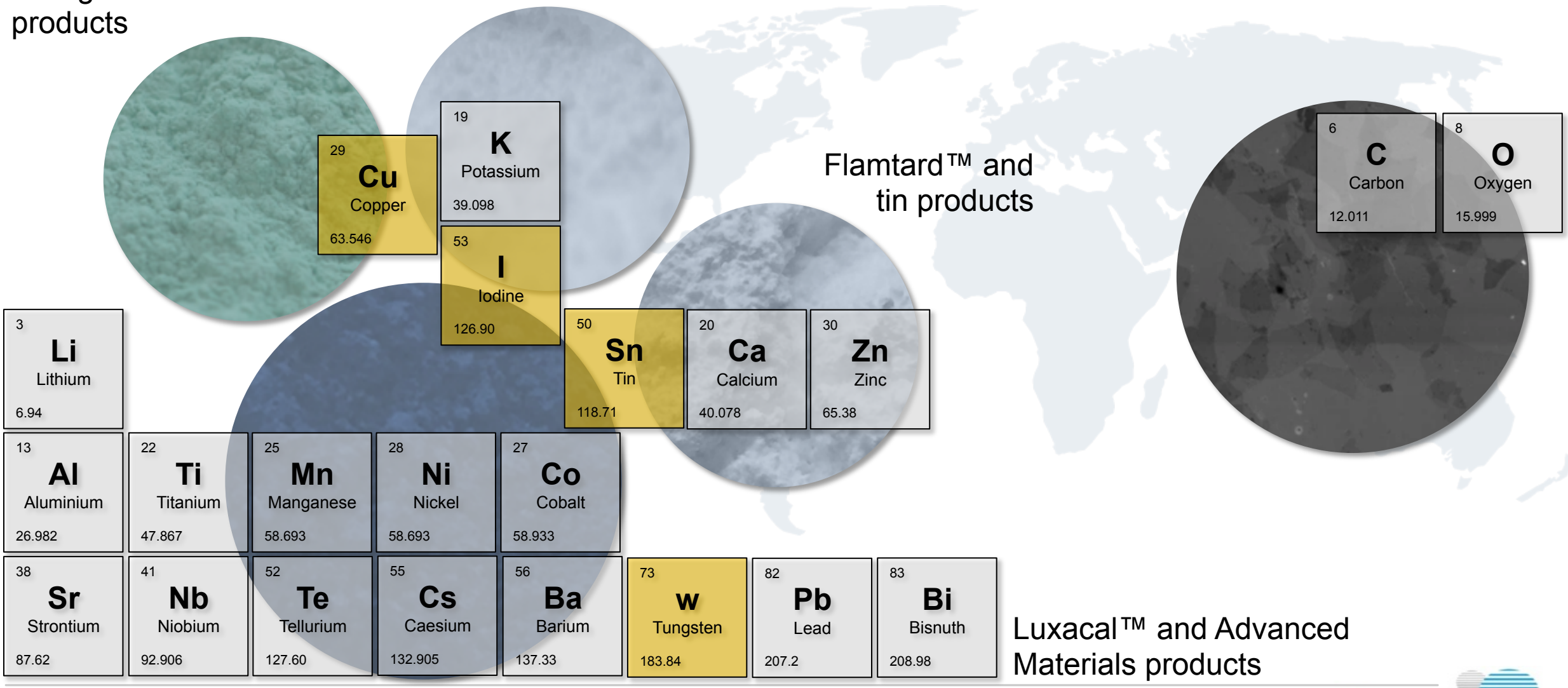
- Health monitoring sensors
- Environmental monitoring sensors
- Wound-care

Product Chemistry

Duraguard™ products

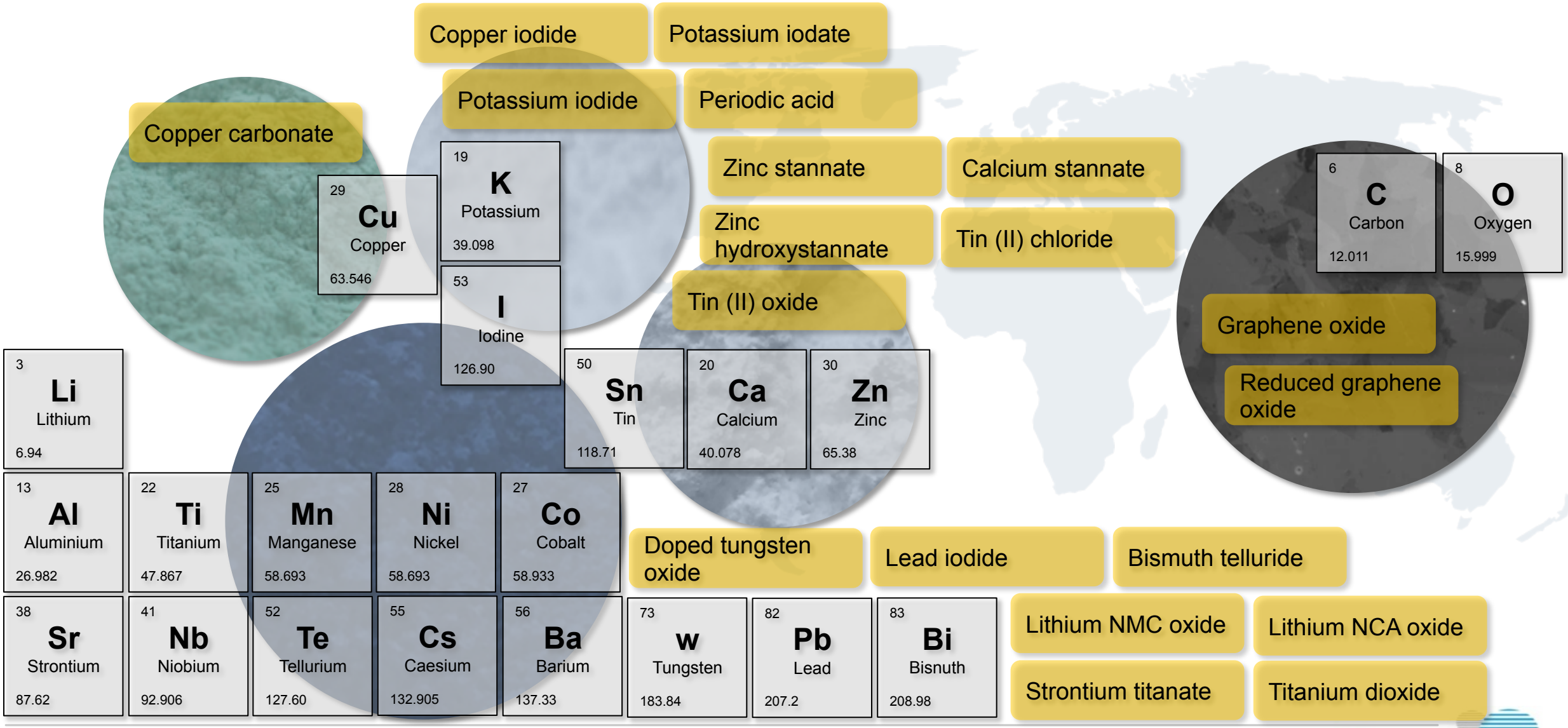
Iodine products

Flamtard™ and tin products



Luxacal™ and Advanced Materials products

Product Chemistry



Applications and Markets

Food and feed additives

Porous H_2S absorbents for natural gas

Polyamide additives for heat and light stabilisation

Chemical mechanical planarization for electronics

Silk screen print cleaning

Polymer additives for improved performance

Flame retardant synergist polymer additives

Sensors

NIR absorption for energy efficiency

Chromium (VI) reduction in cement production

Coatings

Energy harvesting (PV and TEG)

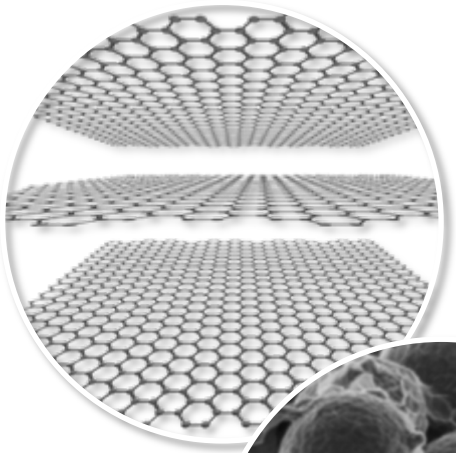
Pigments

Energy storage

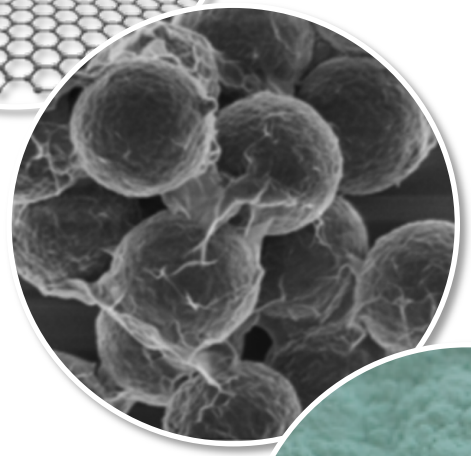
Energy storage (Li-ion batteries and capacitors)

Pollution absorbtion

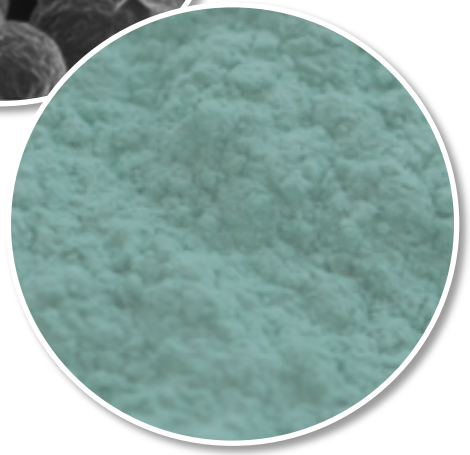
Platform Technologies for Advanced Materials at William Blythe Ltd



Graphene Oxide

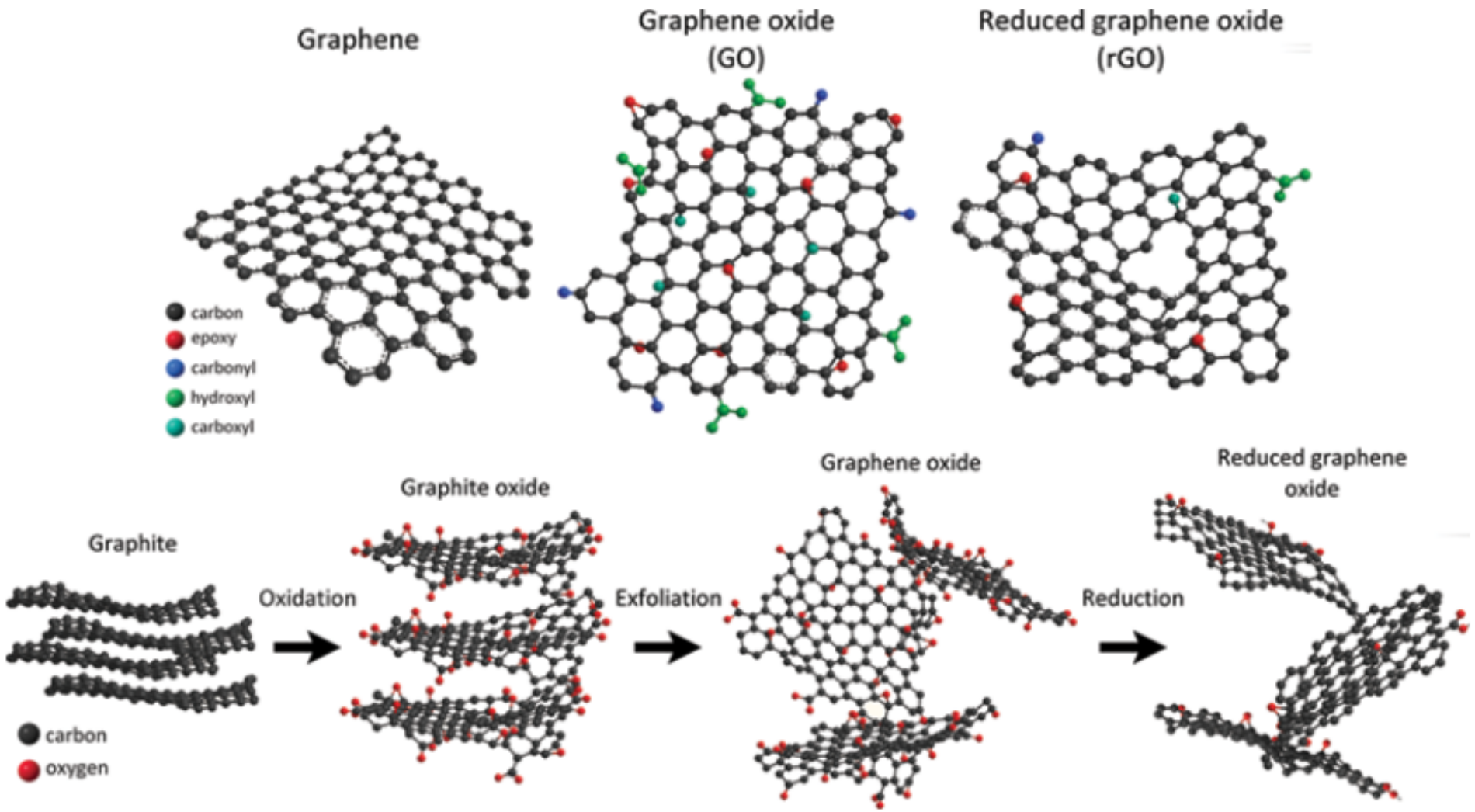


Polymer-Particle Composites



Hydrothermal synthesis of metal oxide (nano)particles

Graphene Oxide



Graphene Oxide from William Blythe Ltd

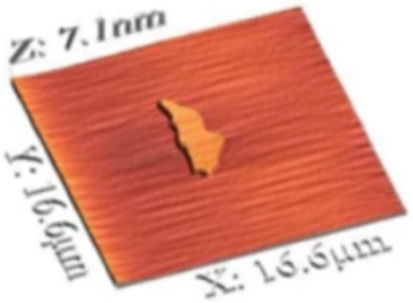
- Consistently high quality graphene oxide produced from graphite using a commercial and scalable process

- Available as:
  - *Aqueous dispersion*
  - *Powder (freeze dried)*
  - *Flake*

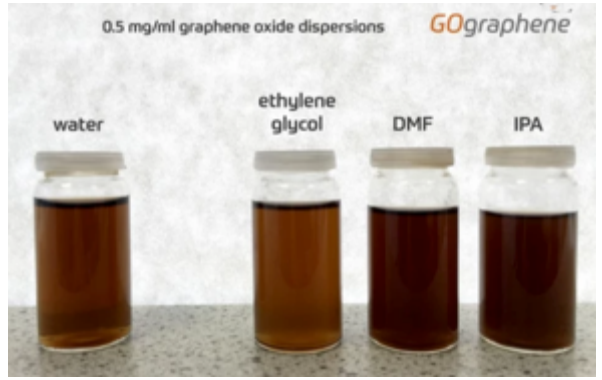
- Specifications:
  - Lateral dimensions ~2-5 microns (AFM, SEM)
  - Mono to bi-atomic layer in dispersion (AFM)
  - Dispersible in highly polar solvents: e.g. water, isopropyl alcohol, dimethyl formamide, ethylene glycol
  - Oxygen content >20% (XPS)
  - Oxygen groups: carboxyl, carbonyl, epoxy, alcohol (FTIR)
  - Trace metal content <0.1% (ICP-MS)
  - Stable at room temperature, complex decomposition profile with major mass loss at 180C and 400C (TGA)

- For R&D purchases and enquiries on commercial quantities, visit: www.go-graphene.com

- Reduced graphene oxide and functionalized graphene oxide derivatives available on request



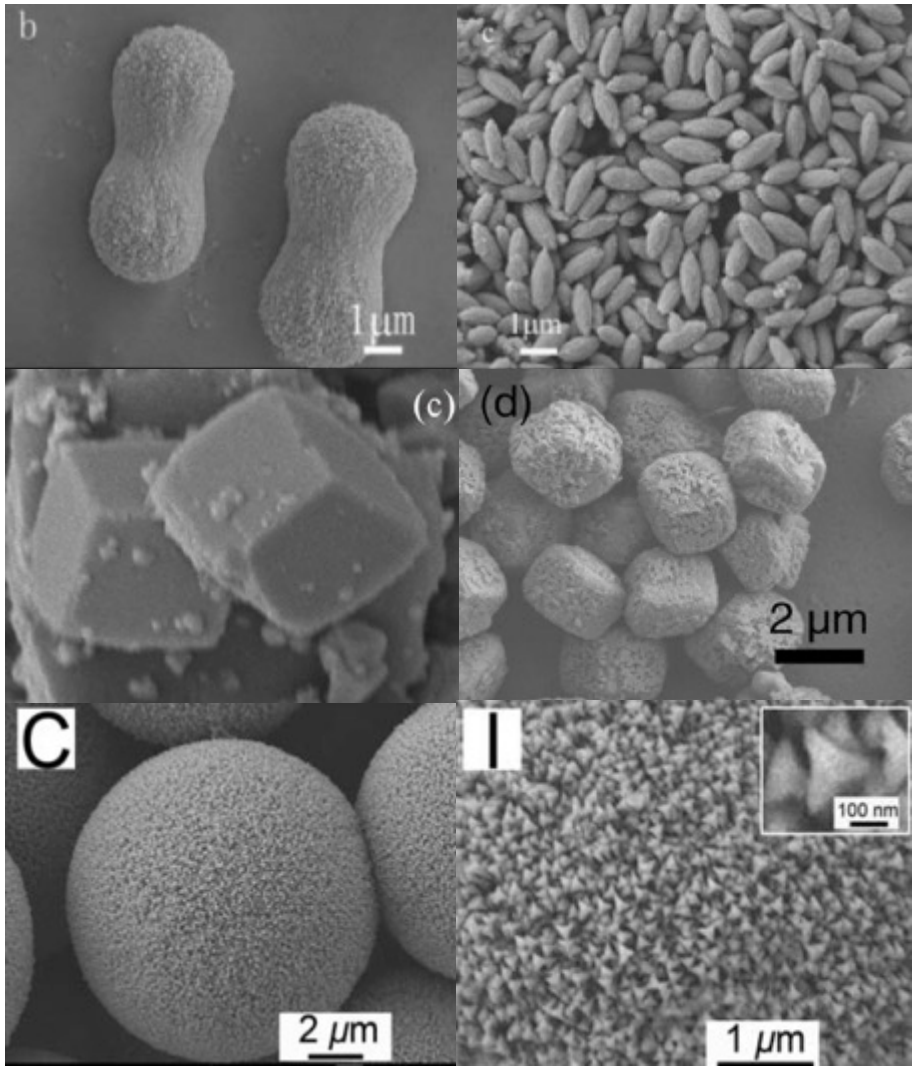
AFM image single flake
William Blythe graphene oxide



Dispersions in polar solvents
William Blythe graphene oxide

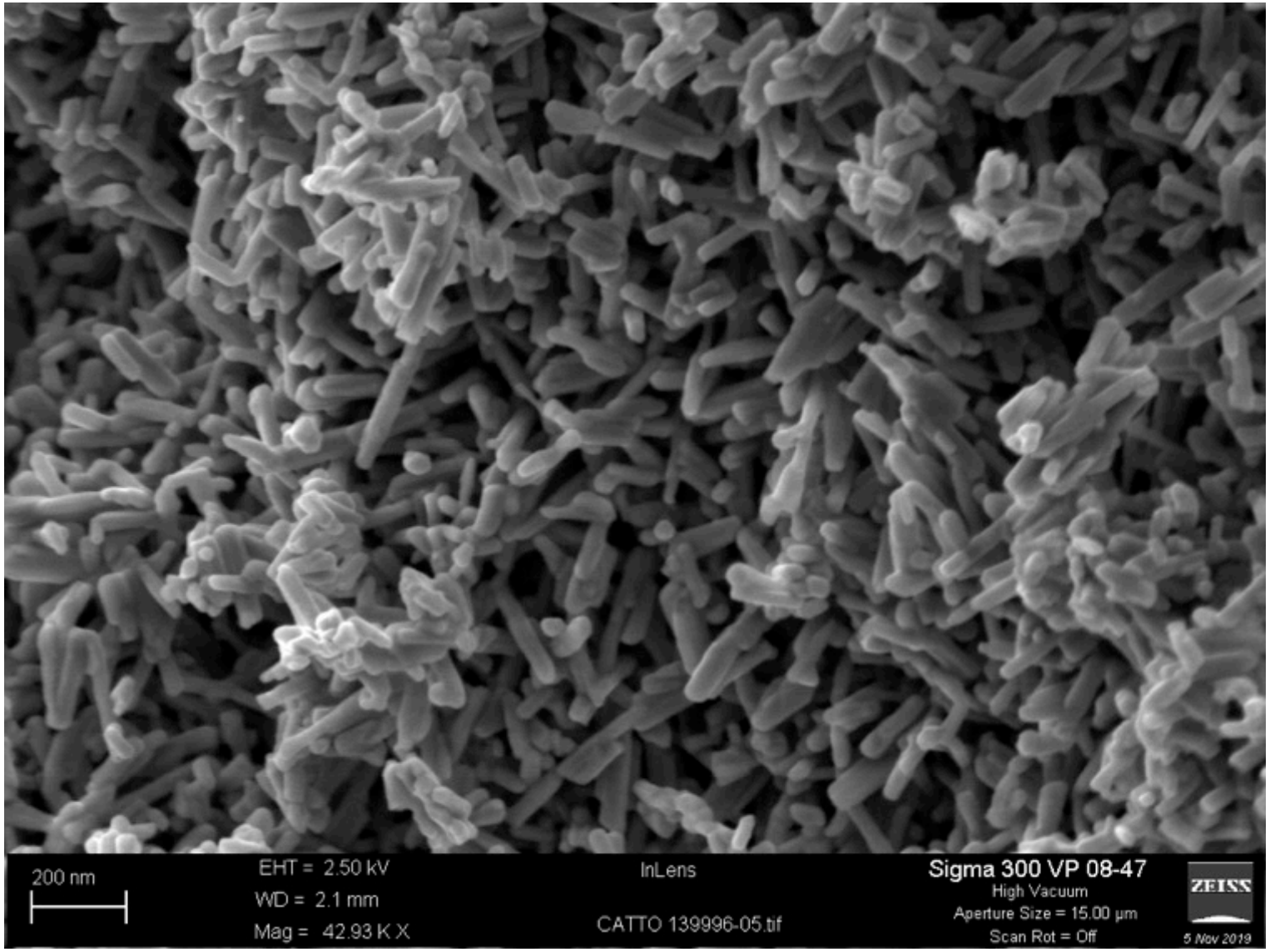
Hydrothermal Synthesis

- Hydrothermal synthesis is the use of water as a reaction solvent above the standard boiling point – usually at autogenous pressure
- The high temperature and pressure make hydrothermal systems useful for synthesising **unusual materials** that are difficult to prepare otherwise
- It also particularly useful for preparing materials with **precise levels of doping**
- High temperatures allow for growth of particles with **specific morphologies**
- William Blythe has hydrothermal capability at 200 mL, 5 L, 44 L and **1000 L**

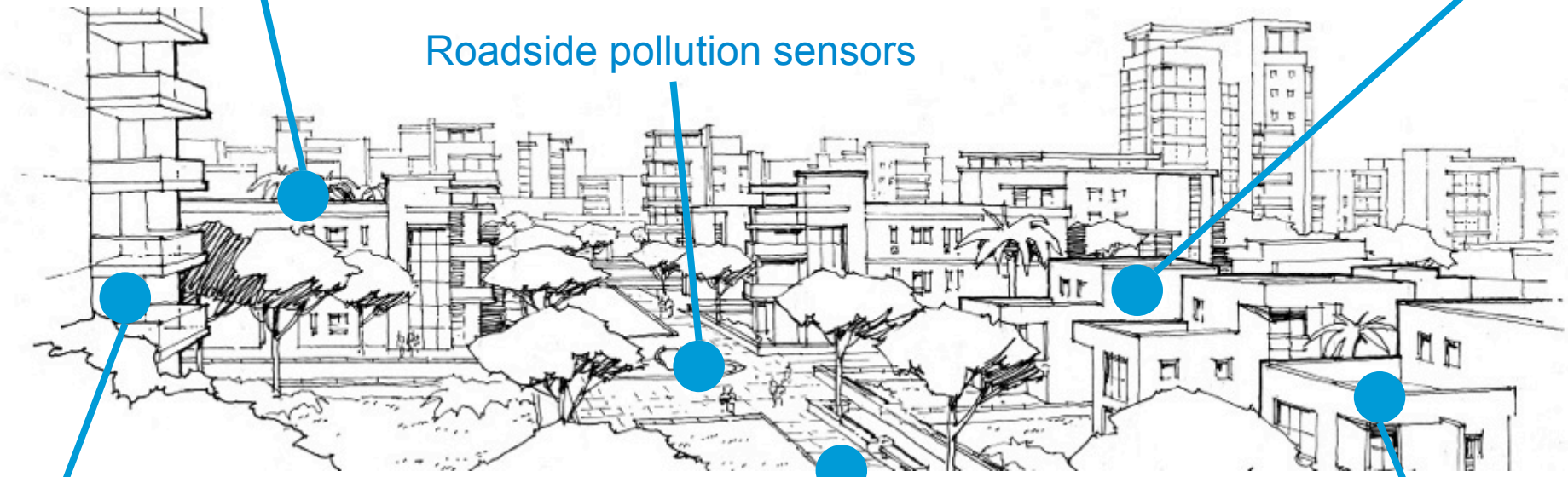


6 different siderite morphologies

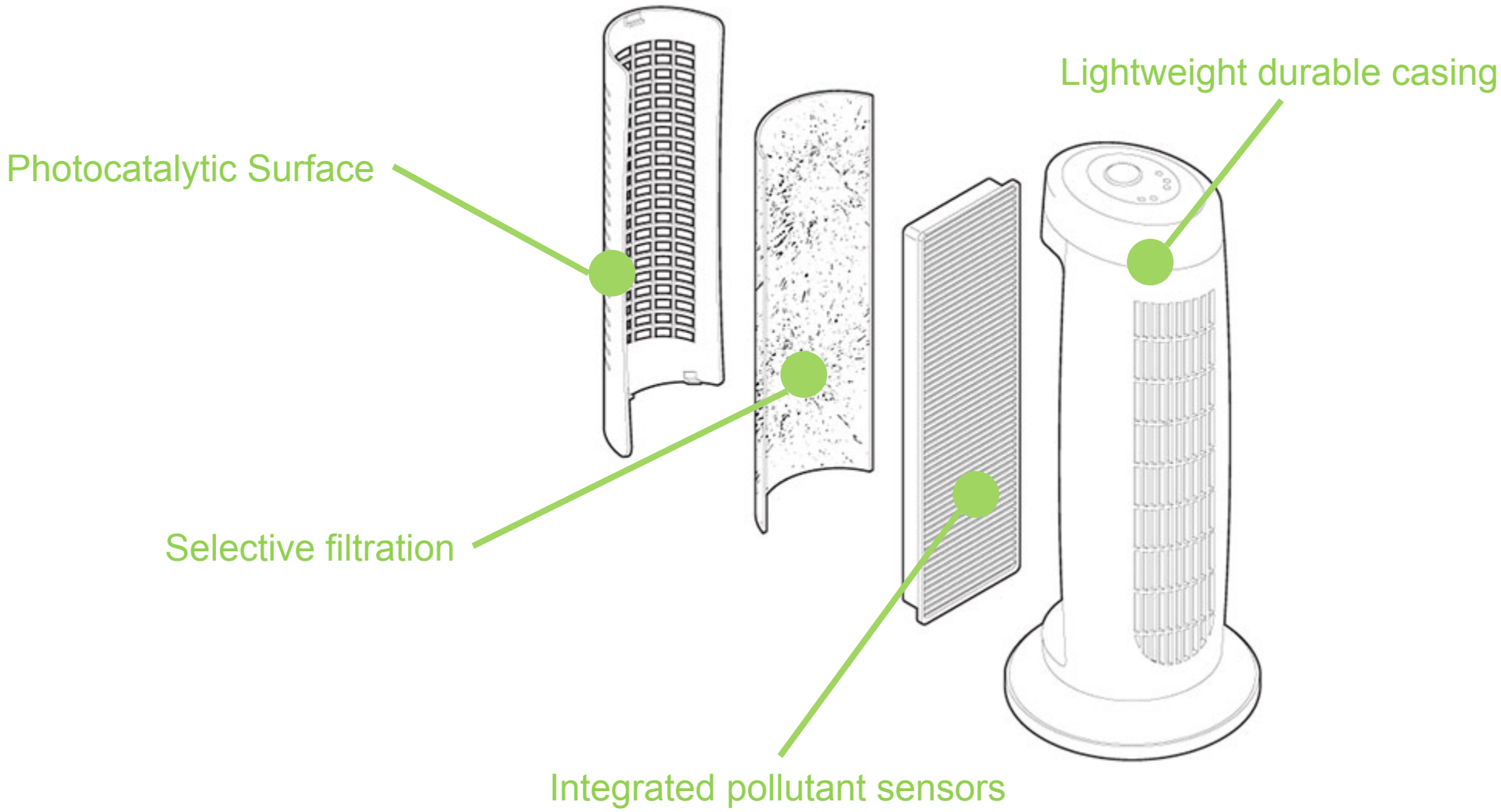
Hydrothermal Caesium Ammonium Tin Tungsten Oxide



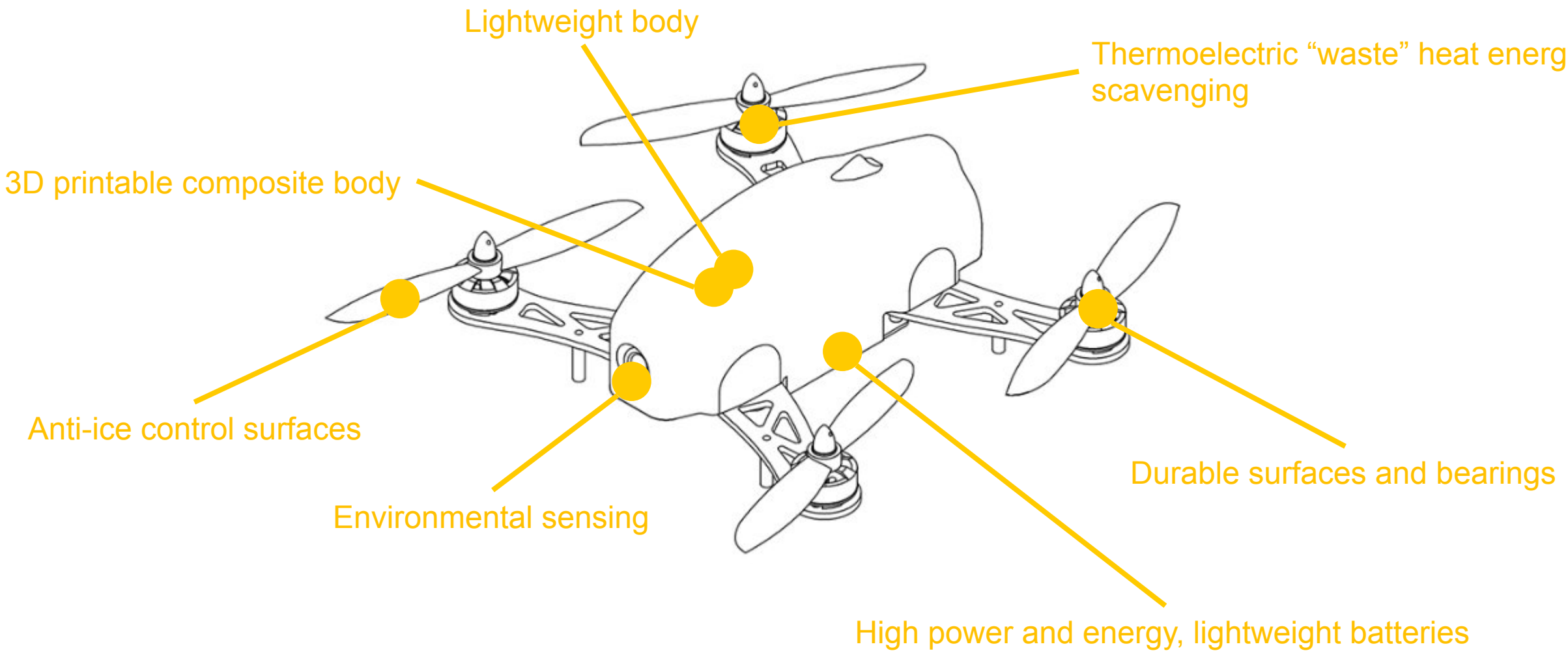
Clean Urban Environment and Smart Cities



Air/Water Cleaning



Transport and Mobility



William Blythe Ltd: Your Partner for Tomorrow's Materials

Thankyou for your attention