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UNITED STATES

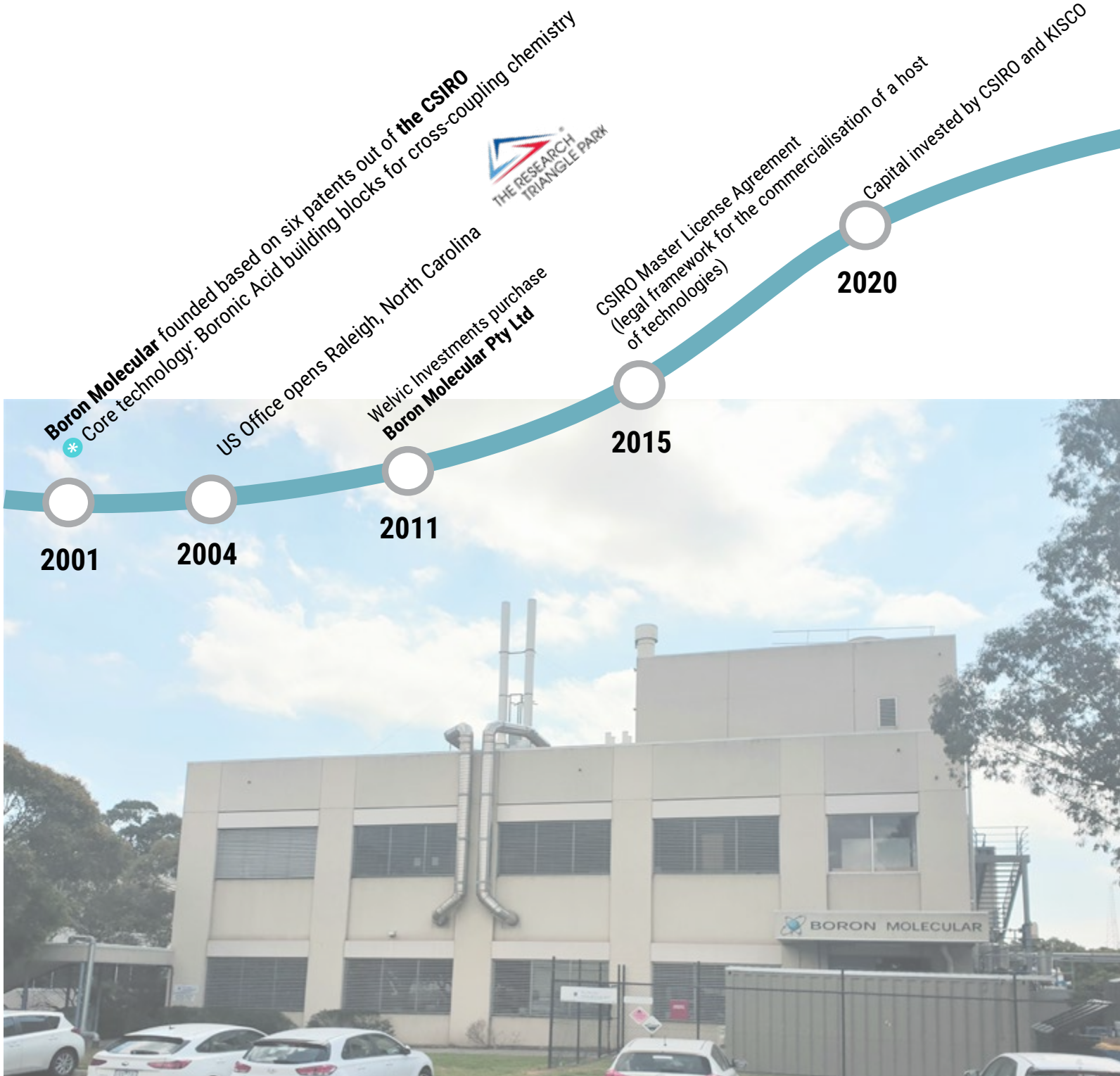
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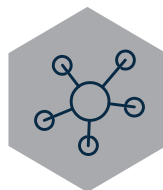
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Boron Molecular

About Us

Boron Molecular is an Australian specialty chemical and polymer manufacturer, based in **Melbourne**. We have successfully commercialised multiple Australian innovations and are active in a number of industry-led research initiatives to increase Australian advanced manufacturing capability. We have extensive supply and distribution networks that we have built over the last 20 years. With a footprint in **Raleigh, North Carolina**, and established agencies across Europe and Asia, we are able to source raw materials competitively. Our team of chemists and chemical engineers have a wide range of expertise across a number of chemical and related industries. Boron Molecular's core business is the **synthesis and production of multi-kilo quantities** from early through to late stage building blocks for export to the global pharmaceutical and material science industries. We have significant experience in undertaking technology transfer projects with companies from within Australia and across the globe.





Products

We have an extensive catalogue of over **2000** discrete small molecule building blocks and novel materials. This includes categories of:

◆ Chemicals

- Boronic Acids
- Heterocycles and Aromatic Building Blocks
- Raft Agents
- Ionic Liquids

◆ Polymers

- RAFT Polymers
- Electroactive Polymers
- Biomaterials Building Blocks

◆ Materials

- Metal Organic Frameworks
- Synthetic Resins

Other compounds included in catalogue: Biaryls, Boronic acid esters, Catalyst, Cubanes, Diborons, Energy Storage Materials, Halides, OLED Materials, Trifluoroborates
Along with these products, we offer excellent **services** such as:

- * Technology Transfer Projects
- * Chemistry & Polymer Services
- * Medicinal Chemistry Services
- * Product and Process Development



Capabilities & Facilities

The headquarters have house administrative offices, wet laboratories, pilot scale production bays and a stand-alone manufacturing facility supported by an extensive quality system, *ISO9001* compliant.

Kilo-lab/ Pilot Plant Facilities

- ✓ Ability to meet broad temperature ranges (-78°C to +180 °C)
- ✓ Large scale filtering, drying and distillation

- glass jacketed reactor with individual heat transfer unit
- glass jacketed filter vessel
- glass vessel for cryogenic reactions
- receiver/separating funnel
- glass jacketed reactors with heat transfer units
- Buchi rotary evaporators
- jacketed, glass lined Buchi reactor in a multipurpose configuration with Del-tatherm heat transfer unit (-60°C to 180 °C), attached overhead addition flask and receivers..
- glass mixing vessel (separating vessel)
- Vacuum drying ovens

Manufacturing Facility

All of the standard unit operations required for synthetic chemistry (heating cooling, reflux, phase separation, distillation, Dean-Stark distillation etc)

Available equipment includes:

FLOW REACTORS

- 100 mL (0°C to 150°C); 350 mL (-40°C to 200°C); 650 mL (-40°C to 200°C); and 1.2 L (-40°C to 200°C) shell & tube flow reactors
- Full suite of pumps, flow meters, regulators, feeder and receiver vessels for different configurations

BATCH REACTORS

- Multiple reactors 30L, 50L, 2X100L, 2X200L, 2X250L, 630L, 1300L (-60°C to 200°C)
- Full suite of feeder and receiver vessels, pumps and auxiliaries for different configurations

Also, we have a 6-inch Wiped Film Distillation unit

Analytical Facilities

Develop and perform extensive in process control and QC release testing utilising a wide array of analytical techniques.

- GCMS – Gas Chromatography with Mass Spectrometry (Triple Quadrupole and TOF GC-MS)
- LCMS & UPLCMS – Liquid Chromatography with Mass Spectrometry. LCMS is a gradient system with diode array UV, auto sampler. Triple quadrupole optics, API source (ApCI and ESI).
- NMR – Bruker Av200 (4.7 Tesla magnet) with a 5mm Quad 1H/13C/19F/31P switchable probe.
- Access to:
 - Bruker DPX300 (7.05 Tesla magnet) with a 5mm quad 1H/13C/19F/31P switchable probe. Variable temperature capabilities
 - Bruker DRX400 (9.4 Tesla magnet) with 5mm Quad 1H, 13C, 19F, 31P switchable probe and a 4mm multinuclear solid state probe. Variable temperature capabilities.
- Polymer Analysis (GPC; DSC; TGA)
- Extensive Quality Management System, which is ISO 9001:2009 Compliant
- Compliant with all local regulatory requirements

In addition the analytical lab undertakes standard physical testing of raw materials and intermediates (melting point, boiling point, UV-Vis determinations, Thin Layer Chromatography etc).

CUSTOM CHEMICAL SYNTHESIS & CONTRACT RESEARCH

Boron Molecular offers a broad range of services for the synthesis of complex and commercially unavailable compounds to the optimization of synthetic routes and supply exclusive chemicals for customer needs. Our research starts from *proof of concept*, which leads to an initial gram quantity, scale up processing resulting in commercial quantities. Boron Molecular's experienced scientists efficiently meet customer needs.



@ Boron Molecular

Boron Molecular's goal is to deliver the highest quality product under custom synthesis program effectively and efficiently at a **competitive price**. We have broad experience in the synthesis of organic compounds of wide structural variety and nearly two decades of experience in satisfying organic synthesis requirements for our clients. We also put in place the necessary confidentiality agreement to give peace of mind that customer's intellectual property will be respected.

With services available in reactors up to 1000L in size and R&D environments, where appropriate, we use *Flow Chemistry Reactor Technology* for custom synthesis projects. Potential benefits for our clients include increased scalability, flexibility, reaction speed, process control, and cost saving.

OUR SERVICES

- * Literature Searches, Evaluation and Project Proposal
- * Synthetic Route development for complex multistep chemistry
- * Custom synthesis with no available procedures
- * Custom synthesis of labelled compounds
- * Custom synthesis of reagents for R&D projects (e.g. from patents or publications)
- * Preparation of API impurities for use as reference compounds in subsequent analyses
- * Replacement of labor- and cost-intensive extraction processes by novel synthetic procedures from gram to multi Kg to MT quantities.
- * Re-designing of synthesis to avoid chromatographic purification
- * Synthesis and extraction of natural products
- * Materials for organic electronics
- * Provide customized packaging and customized specification
- * Chemical Standards/solutions
- * Polymers
- * And more...

Boron Molecular also provides:

- * High-quality synthetic route development toward novel compounds
- * Dedicated project management by business and science professionals; project strategy development

REACTION CAPABILITIES

- | | | |
|----------------|-----------------------|-----------------------------------|
| ◆ Alkylation | ◆ Dehydrohalogenation | ◆ Nitration |
| ◆ Amidation | ◆ Diazotization | ◆ Oxidation |
| ◆ Bromination | ◆ Esterification | ◆ Organometallic Custom Synthesis |
| ◆ Borylation | ◆ Ethoxylation | ◆ Polymerization |
| ◆ Condensation | ◆ Hydrogenation | ◆ Quaternization |
| | | ◆ Sulfonation and much more |

ANALYTICAL CAPABILITIES

Boron Molecular can provide complete analytical support, with comprehensive QC data packages or individual analytical techniques including multinuclear NMR, UPLC, LC-MS, IR, optical rotation, and micro-analysis.

Our state-of-the-art synthetic labs are equipped with modern preparative and analytical tools:

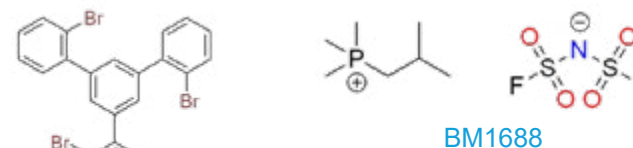
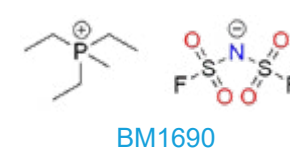
- ◆ NMR spectroscopy (200 MHz; ¹H; ¹³C; ⁵B; ¹⁹F; Higher field NMR up to 600MHz is available on request.
- ◆ Electrospray MS, other techniques available on request
- ◆ Liquid Chromatography–Mass Spectrometry (LC-MS)
- ◆ Ultra-Performance Liquid Chromatography (UPLC)
- ◆ Gas chromatography (GC)
- ◆ Method development and data interpretation
- ◆ Optical rotation, microanalysis, FT-IR
- ◆ Ion exchange Chromatography

Boron Molecular also offers unique services for a custom compound library. Our scientifically trained personnel are pleased to help our clients to create a unique compound library, designed to meet their exact screening requirements.

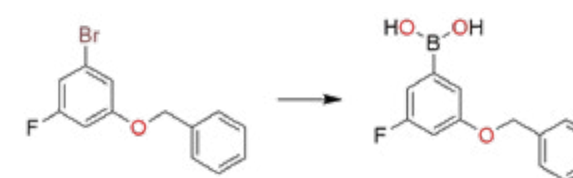
ADVANTAGES

- ◆ Reduce costs and waste
- ◆ Save time and effort
- ◆ Ensure exact requirements are met: Target structure; Required amount and Comprehensive analytics

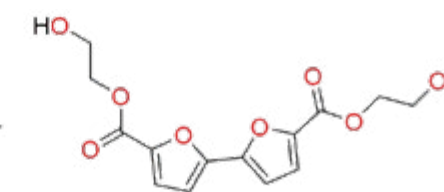
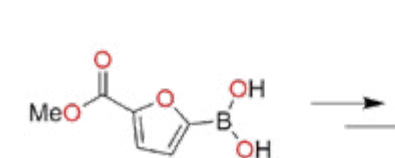
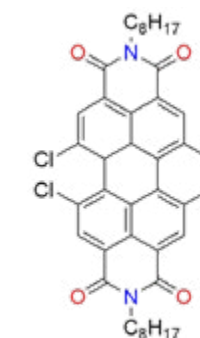
RECENT CUSTOM PRODUCTS

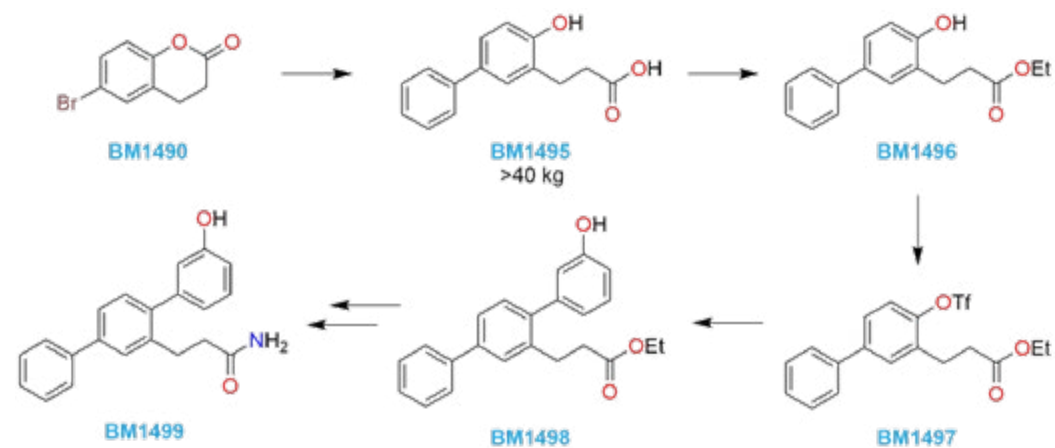
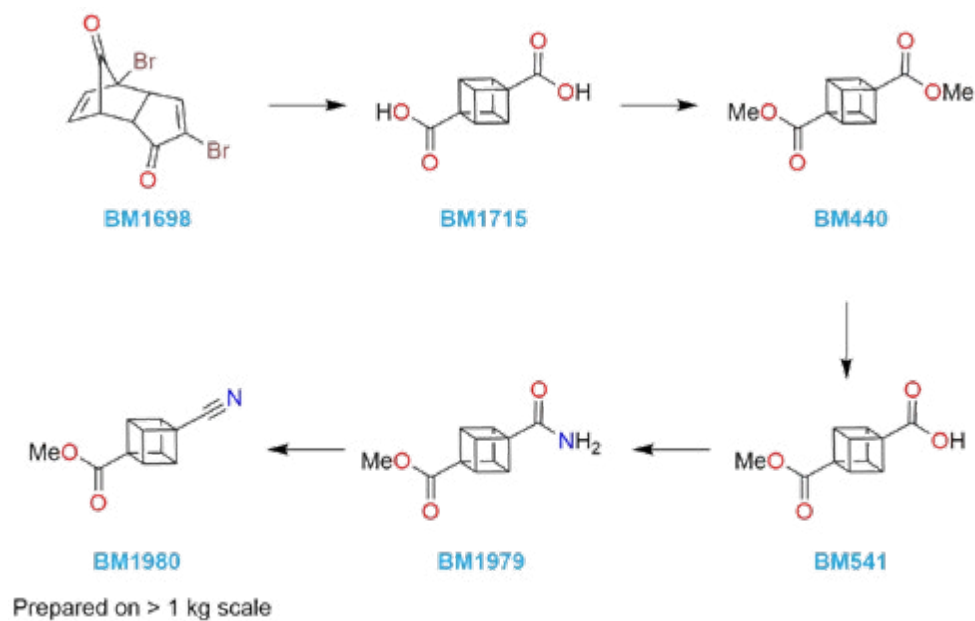


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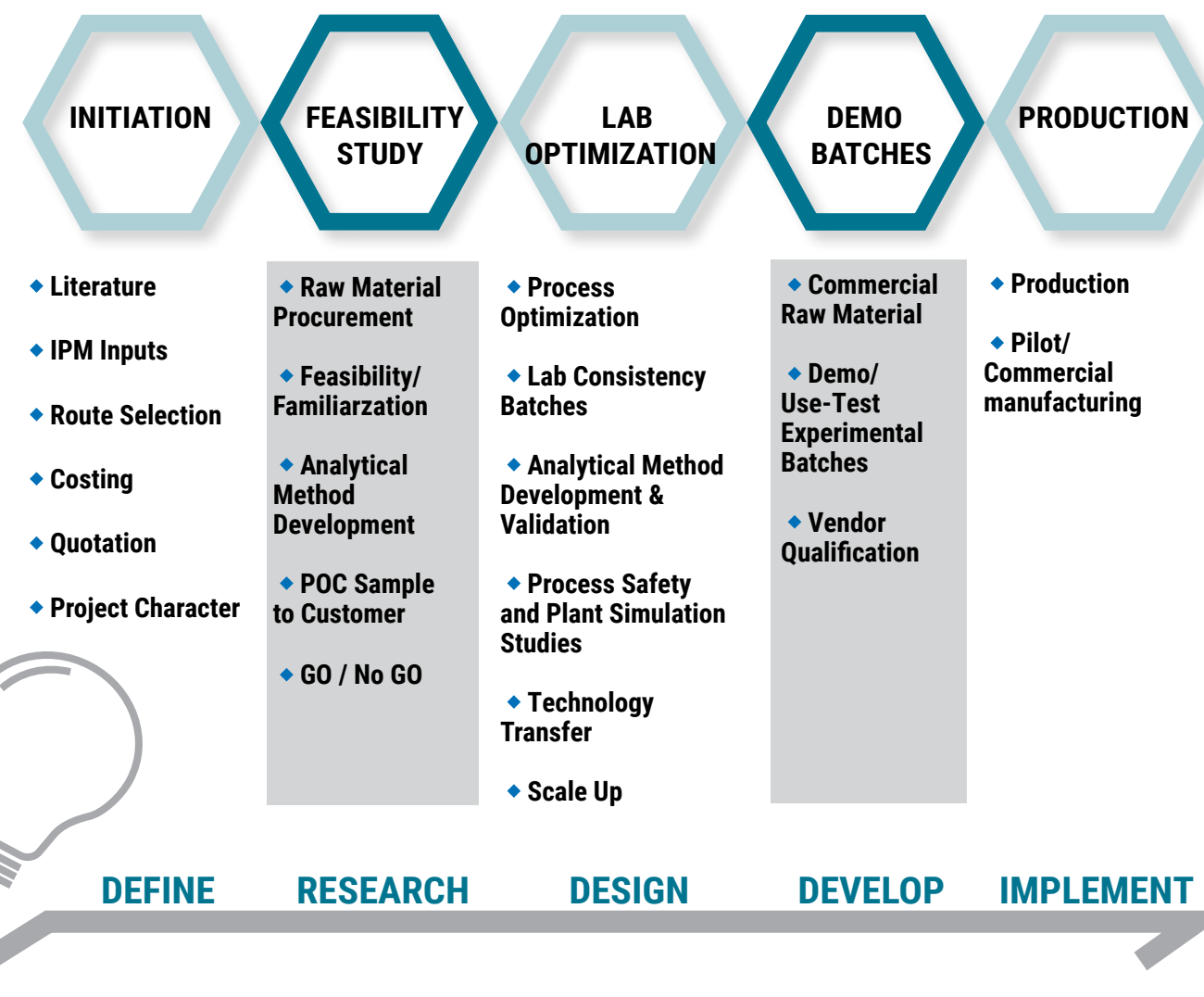


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PRODUCT DEVELOPMENT



PARTNERSHIP

Research Partners



The Kyung-In Synthetic Company (KISCO)



Deakin University



Calix Ltd

Regional Partners



Japan, Korea, Europe: Nagase



Taiwan: Eumate International Corp.



Europe: Messin Consulting

MS3 Art Conversation Resins



UK, Europe & Russia: Deffner & Johann GmbH



VALUES

- ✓ High level of customer satisfaction
- ✓ Continual improvement
- ✓ Meeting customer and applicable regulatory requirements
- ✓ The product supplied to the time, budget and quality requirements



BORON
MOLECULAR

Our Products

RAFT / Boronic Acids / MOFs /
Ionic Liquids and other battery materials

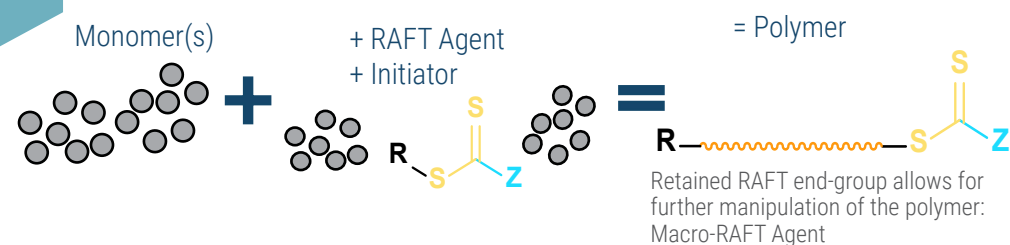
Controlled free radical polymerisation

RAFT

ABOUT RAFT

RAFT (Reversible Addition Fragmentation chain Transfer) polymerization technology represents a versatile technique for making polymers. This technology has revolutionized polymer synthesis and spawned a new generation of polymeric materials, with many applications in a wide range of fields including engineering materials, electronics, healthcare and biotechnology expected.

Using RAFT polymerization technology the production of well-defined, end-functionalized polymers, with precisely controlled structure, molecular weight, polydispersity, and with varied functionality can be easily achieved. RAFT is tolerant to a wide variety of reaction conditions and functionalities, and can be performed on existing conventional free-radical polymerization equipment.



KEY APPLICATIONS OF RAFT

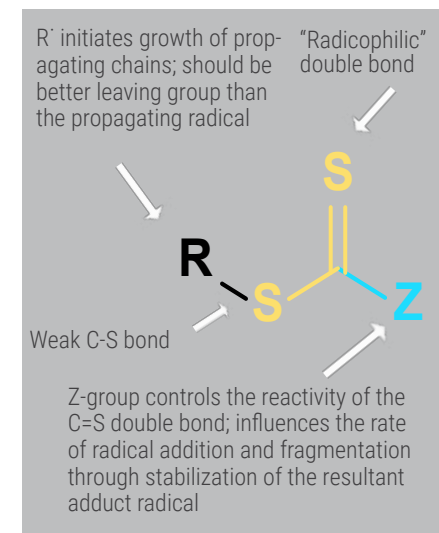
Raft is very broadly applicable to polymers particularly in the areas of industrial, personal care, agriculture and biomedical polymers where higher order functionality is required. These versatile, low odour, low cost RAFT Agents are now available in gram to metric tonne quantities.

- ◆ Paint
- ◆ Electronics components (OLED materials)
- ◆ Personal care products
- ◆ Rubricants & Coating
- ◆ Healthcare products
- ◆ Cosmetics
- ◆ Adhesives

RAFT AGENTS

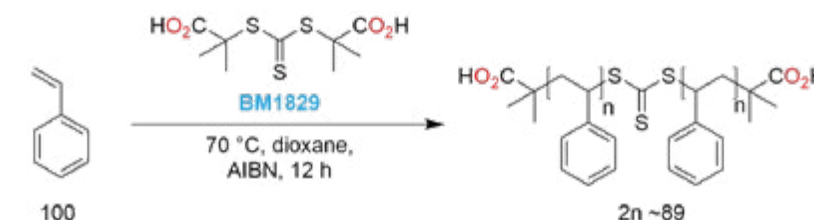
At the heart of the RAFT process is the **RAFT Agent**, a small molecule that is responsible for controlling the polymerization process. The RAFT Agent exerts its influence through controlling the steady-state concentration of the propagating polymer chain radicals, and this function is profoundly influenced by the nature of the monomer(s) being polymerized.

The general structure and key features of a RAFT Agent is shown here. A RAFT Agent typically has a radicophilic thiocarbonylthio group (S=C-S) with substituents R and Z that impact the polymerization reaction kinetics and, importantly, the degree of control. Because of this complex interplay it is not possible for a single RAFT Agent to effectively polymerize all monomer classes.



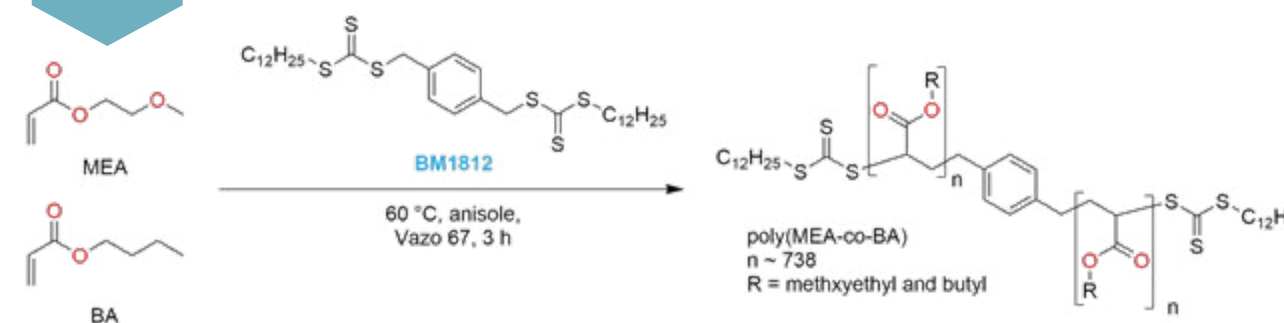
EXAMPLE PROCEDURES

BM1829



Literature reference: ACS Omega 2018, 3, 562-575

BM1812

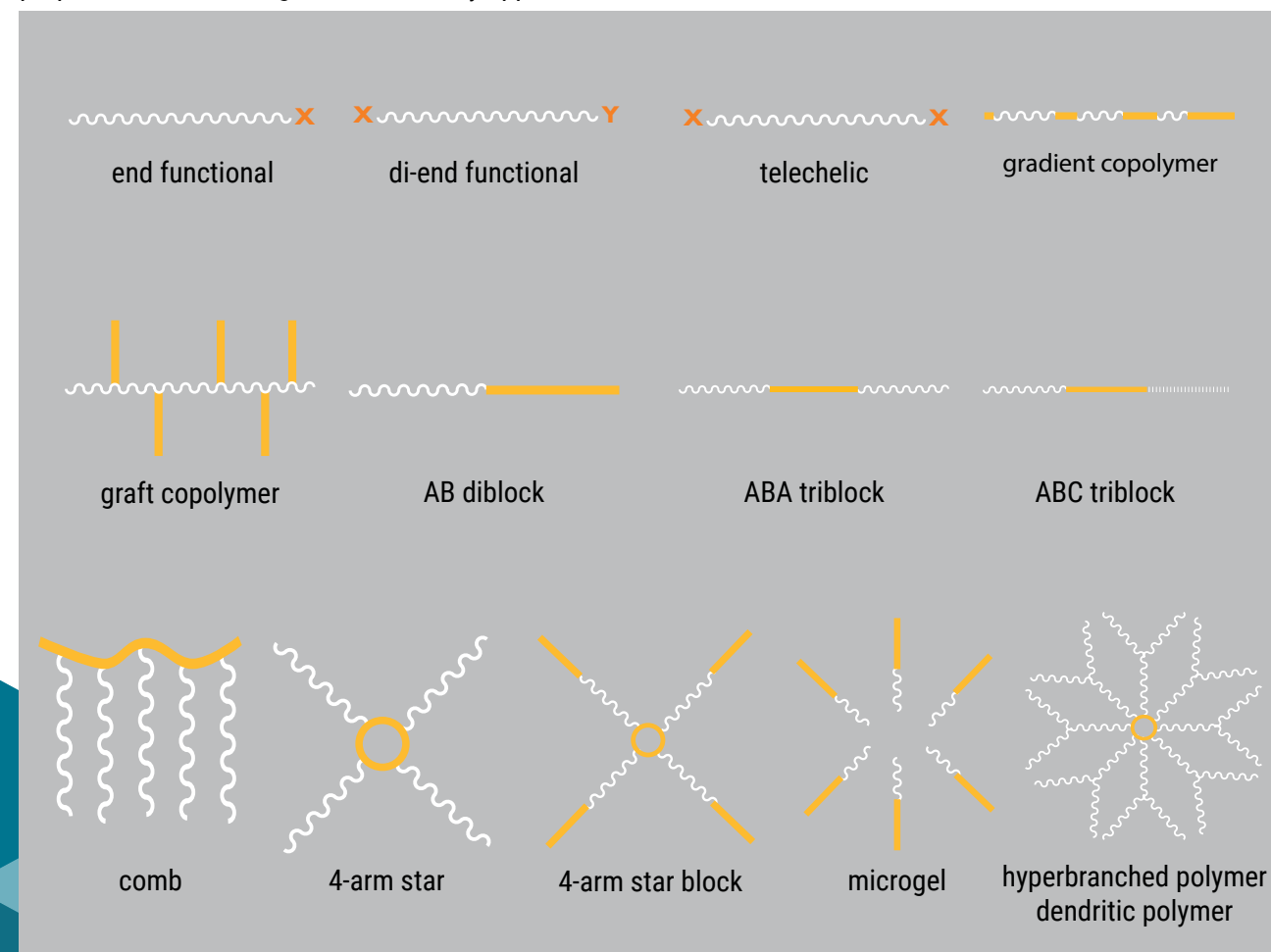


Literature reference: PCT Int. Appl. (2018), WO 2018151034 A1 20180823

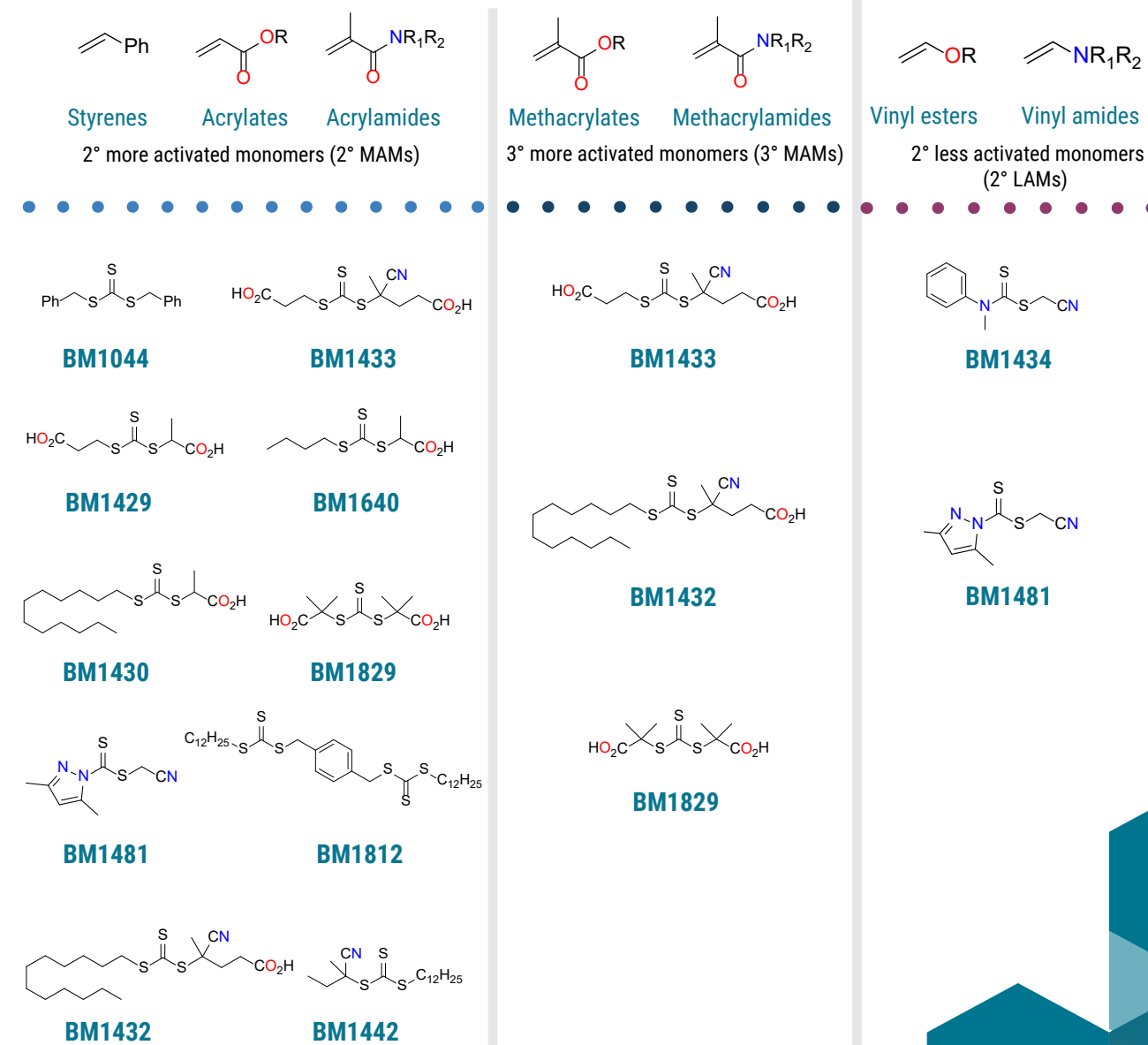
RAFT POLYMERIZATION

RAFT gives access to polymers of predetermined molecular size with very narrow molecular size distribution. It also allows the controlled synthesis of complex structures such as diblock, multiblock, hyperbranched and star shaped polymers, polymeric microgels and nanospheres.

Controlled size and narrow size distribution are important because they desirably impact many properties, such as viscosity and processability, while structures such as multiblock and star shaped polymers have unique properties that are sought after for many applications.



RAFT AGENT MONOMER SELECTION GUIDE



RAFT AGENTS - SELECTION TABLE

Boron Molecular has developed a set of RAFT Agents for both commercial and R&D applications. These versatile, low to no-odour, low cost RAFT Agents are now available in gram to metric tonne quantities. The RAFT Agents – Selection Table is designed to assist the RAFT Technology user to choose the right RAFT Agent to ensure the best polymerization outcome.

	Log P*	STYRENES	ACRYLATES	ACRYLAMIDES	METHACRYLATES	METHACRYLAMIDES	VINYL ESTERS	VINYLAMIDES
 BM1430	6.56	●	●	●	●	●	●	●
 BM1429	1.54	●	●	●	●	●	●	●
 BM1640	3.22	●	●	●	●	●	●	●
 BM1044 (purity > 99%)	5.68	●	●	●	●	●	●	●
 BM1812	15.0	●	●	●	●	●	●	●
 BM1442	7.91	●	●	●	●	●	●	●
 BM1433	1.90	●	●	●	●	●	●	●
 BM1434	3.47	●	●	●	●	●	●	●
 BM1481	2.56	●	●	●	●	●	●	●
 BM1432	6.93	●	●	●	●	●	●	●
 BM1829	2.52	●	●	●	●	●	●	●

● solvent soluble
● water and solvent soluble (amphiphilic)

*Log P estimated from ChemDraw

● Excellent control of MW; narrow PDI (< 1.1)
● Good control of MW; broad PDI (>1.3)

● Excellent control of MW; moderate PDI (1.1–1.3)
● Not suitable

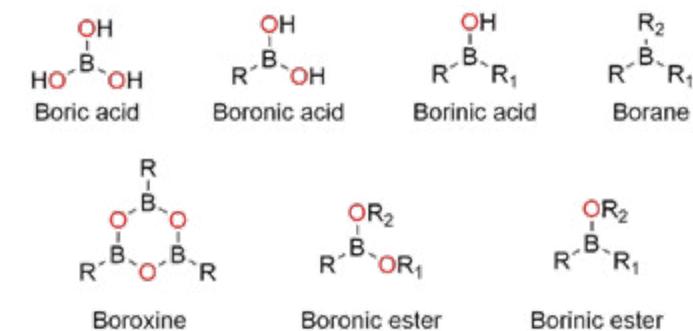
Use in numerous **synthetic applications**

BORONIC ACIDS

ORGANOBORANES-MEET THE FAMILY

Suzuki and co-workers paved the way in the field by the discovery of the coupling between aryl halides and alkenylboronates. Since this discovery, the aptly named “Suzuki- Miyaura’ coupling reaction has been extended to include a range of aryl, alkenyl, alkynyl and heteroaromatic coupling partners and has the ability to form C-C, C-N, C-O, C-X, C-H and B-O bonds. In 2010, the importance of this discovery was recognised by naming its discoverers as one of the recipients of the Noble prize for Chemistry.

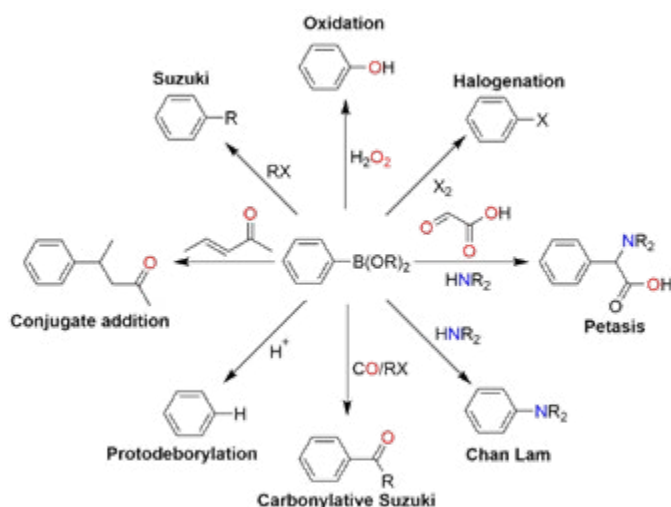
Boronic acids and their derivatives are a structurally diverse family that have become important synthetic intermediates in many different fields of chemistry. The family ranges in oxidation states, from the fully oxygenated boric acid through to boronic acid and borinic acid, containing two and one oxygen species respectively, to boranes which contain only C-B bonds. While boranes and borinic acids react quickly with air, boric acid and many boronic acids are air and moisture stable, leading to their use in numerous synthetic applications.



USES OF BORONIC ACIDS

- ◆ Biaryls, OLED materials and polymers.
- ◆ Pharmaceutical and cosmetic drug synthesis.
- ◆ Bioactive materials.
- ◆ Sensors for saccharides, amines and other reactive species.
- ◆ Catalysts for the activation of alcohols and carboxylic acids.

BORON CHEMISTRY AT BORON MOLECULAR



For nearly two decades, Boron Molecular has consistently developed and delivered the highest quality boronic acids to our customers at a competitive prices. As a result, we have broad experience in the synthesis of a range of diverse boronic acids, ester, and trifluoroborate salts from discovery through to hundreds of kilos.

Downstream, our experience with boronic acids is as varied as it is important. We have kept pace with developments as Boron chemistry has been extended to include a range of aryl, alkenyl, alkynyl and heteroaromatic coupling partners enabling the efficient formation of C-C, C-N, C-O, C-X, C-H and B-O bonds.

Check out our catalogue or talk to us confidentially about your custom needs. We excel at meeting rigorous quality specifications.

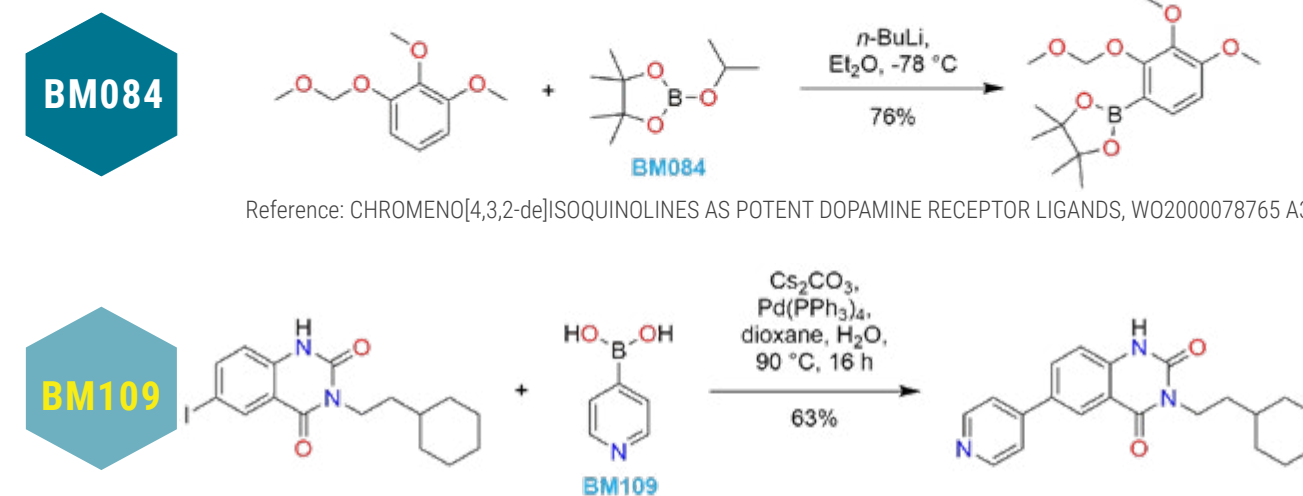
BORONIC ACIDS/ESTERS

Boron Molecular offers boronic acids in several forms, including boronic acid esters and trifluoroborates, in addition to the free acids. Esters of boronic acids can be used advantageously depending on the application and, in some situations, are superior and crucial to the success of the synthesis or purification of compounds. The use of esters has been recommended for Suzuki Couplings in cases where the organoboronic acids are sensitive to hydrolytic deboration.

Some **advantages** of the ester analogues of boronic acids include:

- ◆ Unlike many parent organoboronic acids the corresponding pinacol esters are discrete molecules which are easily characterized and often purified by chromatography
- ◆ The pinacol esters are in general more soluble in organic solvents
- ◆ In some instances, the pinacol esters can be used as protecting groups to eliminate unwanted side reactions

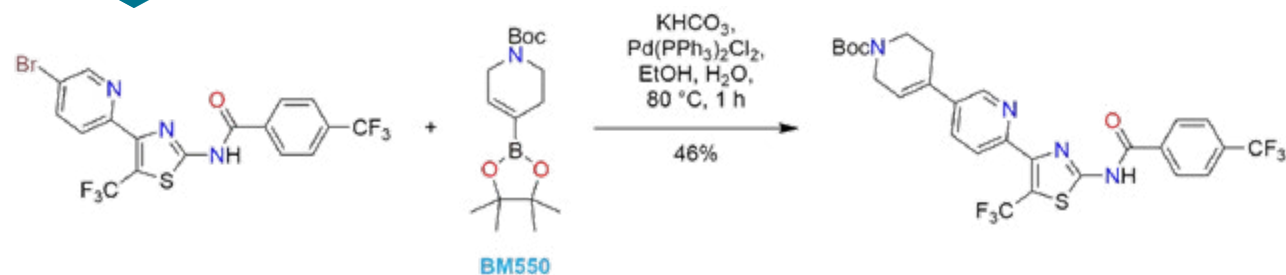
USE OF OUR PRODUCTS-EXAMPLES



Reference: CHROMENO[4,3,2-de]ISOQUINOLINES AS POTENT DOPAMINE RECEPTOR LIGANDS, WO2000078765 A3

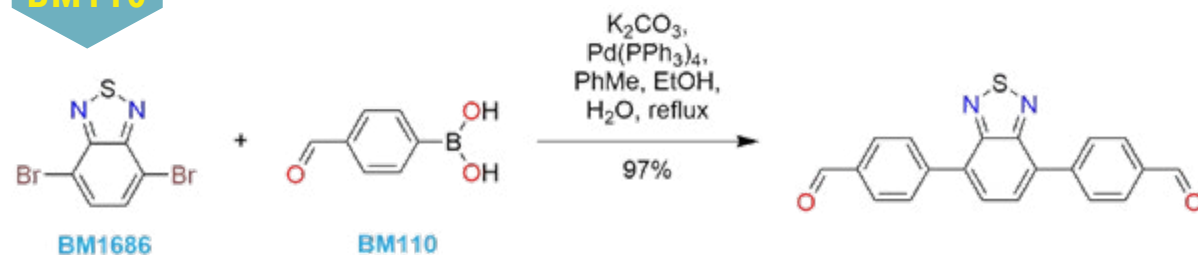
Reference: Journal of Medicinal Chemistry, 63(6), 3066-3089; 2020

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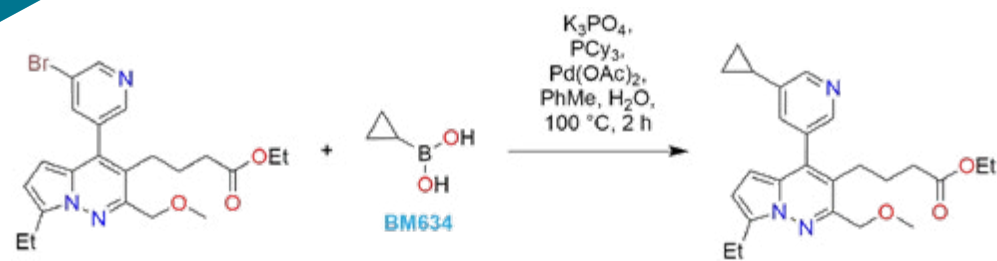
Reference: ANTIPARASITIC COMPOUNDS, WO 2016/183173 A1

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BM110



Reference: Synthetic Metals 259 (2020) 116235

BM634



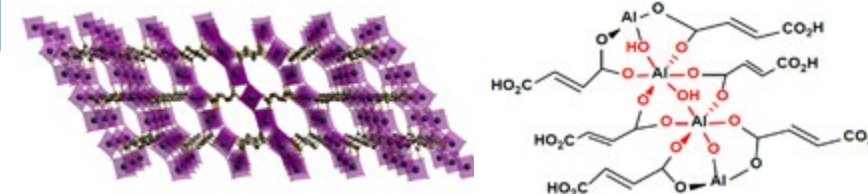
Reference: new pyrrolopyridazine derivatives, WO 2004/063197 A1

Non-hazardous water capture material

MOFs

METAL ORGANIC FRAMEWORKS

Metal Organic Frameworks (or MOFs for short) are a class of compounds consisting of organic ligands bound to metal ions or clusters. These porous materials can form one, two or three dimensional structures in a repeating, **crystalline network**. The result of this structure is in an extremely large surface area, with some MOFs having a surface area of more than 7800 m^2/g . The different properties of MOF's, such as surface area, pore size, density, chemical functionality and geometry can all be altered by changing the metal ion or organic ligand, and it is this tunability that make there compounds so popular.



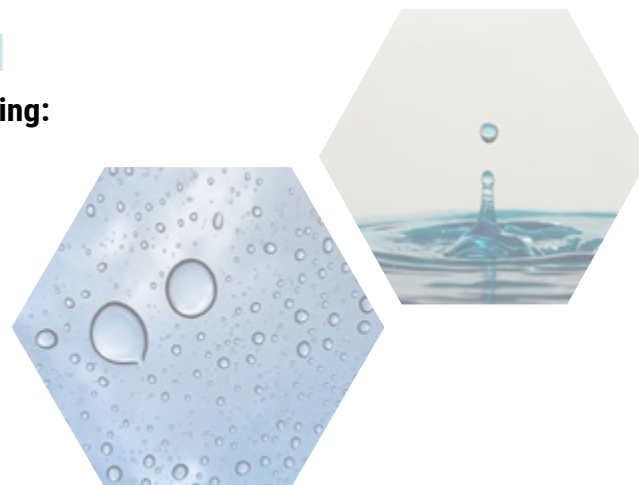
Pioneered in the 1990s, there are now over **90,000 unique MOFs** present it in the literature.

Boron Molecular is excited to be able to provide bulk quantities of some of these versatile and useful materials.

APPLICATIONS OF MOFs

MOFs have a wide range of applications including:

- ◆ Hydrogen Storage
- ◆ Water Capture
- ◆ Catalysis and Electrocatalysis
- ◆ Carbon Capture
- ◆ Drug Delivery
- ◆ Nuclear Waste Capture



CASE STUDY: ALUMINIUM FUMARATE

BM1811 Aluminium fumarate as a paste



Aluminium fumarate is a non-hazardous member of the MOF family that has a wide range of applications due to its remarkable thermal and moisture stability. It is comprised of alternating aluminium ions and fumarate ligands. Its high surface area and ultrahigh microporosity allows for large amounts of water (or other guest molecules) to be attracted to the surface of its **crystal framework** and could be used in potential applications such as in dehumidifiers, as an adsorption heat pump (i.e. use in refrigeration and air conditioners) or even for CO₂ or methane capture (from landfill or power plants).

Features of Aluminium Fumarate include:

- ◆ High porosity (~0.66cm²/g)
- ◆ High Surface area (~1000 m²/g)
- ◆ High Thermal Stability (≤400°C)
- ◆ High moisture stability
- ◆ Pore size suitable for water vapour
- ◆ Bulk quantities available
- ◆ Readily producible

Customer benefits include:

- ◆ Cheap to operate
- ◆ Reusable
- ◆ Easy to regenerate
- ◆ Stable under a range of conditions
- ◆ Safer than LiCl to handle
- ◆ Doesn't leach

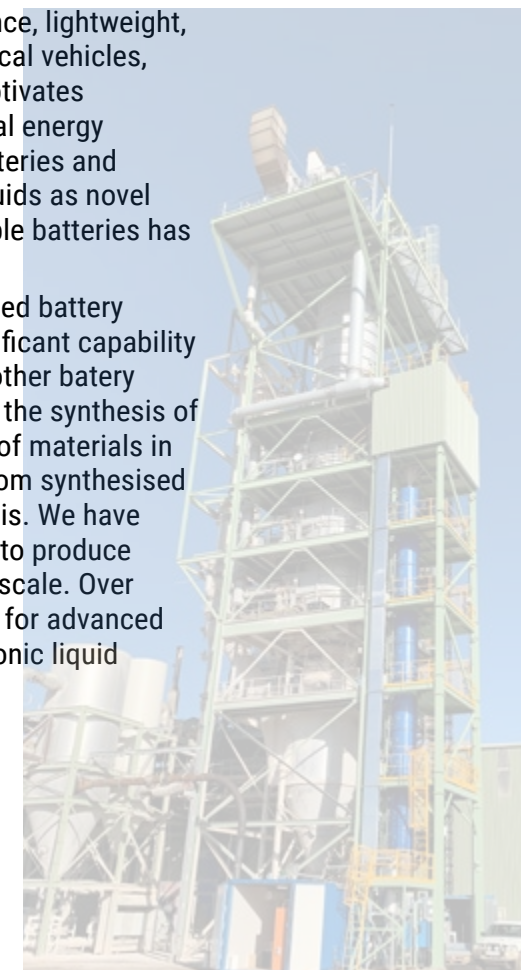
Innovative solutions for **energy needs**

Ionic Liquids & other battery materials

NEXT GENERATION BATTERIES

In recent years, the demand of high-performance, lightweight, low cost, portable electronic devices in electrical vehicles, aerospace, medical systems, etc., strongly motivates researchers towards advanced electrochemical energy storage devices and technologies such as batteries and supercapacitors. The potential use of ionic liquids as novel electrolytes for various secondary, rechargeable batteries has attracted great interest.

In order to meet the future demand for advanced battery technology, Boron Molecular has built up significant capability to manufacture high quality ionic liquids and other battery materials for the energy sector. Specialised in the synthesis of high-purity ionic liquids, we provide a number of materials in our catalogue and also supply a range of custom synthesised ionic liquids to customers on an exclusive basis. We have pilot scale resin exchange facilities enable us to produce a variety of electrolyte configurations on pilot scale. Over the next few years, we will develop a blueprint for advanced manufacturing hub of nano-active materials, ionic liquid electrolytes, and packing technology.

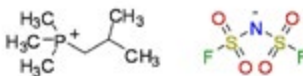


OUR PRODUCTS- IONIC LIQUIDS

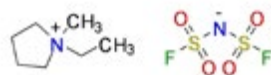
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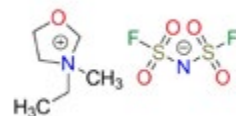
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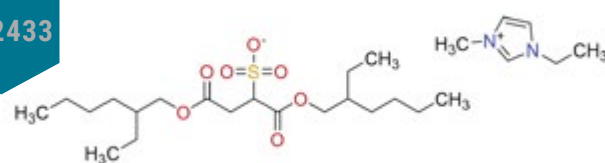
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BM2088



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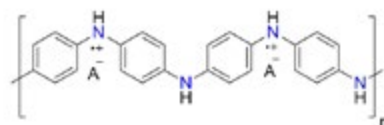
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PANI(POLYANILINE)

The electroactive polymer technology represents the 9th Technology licensed to Boron Molecular. The electroactive polymer technology is based around a polymers called polyaniline (PANI). PANI is a well-studied **electroactive polymer** with high intrinsic electrical conductivity and unique among conducting polymers as its conductivity can be reversibly controlled. Through collaboration partners Boron Molecular has developed a scalable method for the production xylene soluble solutions of highly defined and high quality doped PANI in commercial quantities. This material has a broad range of applications in the development of materials that are able to dissipate electrostatic potentials and also in the development of **batteries, capacitors**, electrically conductive materials, coatings and composites. Other commercial applications of PANI include: electrostatic dissipation; anticorrosion coatings; rechargeable batteries; various electronic devices; sensor; organic photovoltaics; and separation membranes, electromagnetic interference shielding, sensors, actuators.

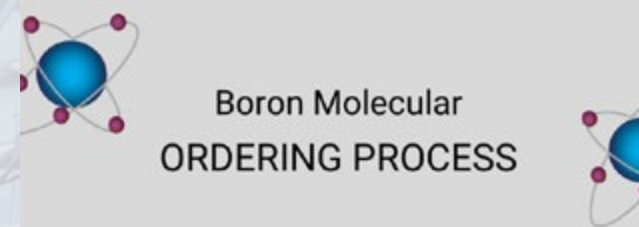
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Shop chemicals **online**

Ordering Process

We have an extensive catalogue of over 2000 discrete small molecule building blocks and novel materials. Order directly from our product catalogue.



BROWSE

Choose from our wide range of chemical products in 'Catalogue' by using CAS number or product name or BM code.

You found something you like? check SDS if you'd like to and just "add to cart"



ADD TO CART



PAYMENT

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DELIVERY



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