From flatscreen TVs to your smartphone:

the element boron deserves more attention

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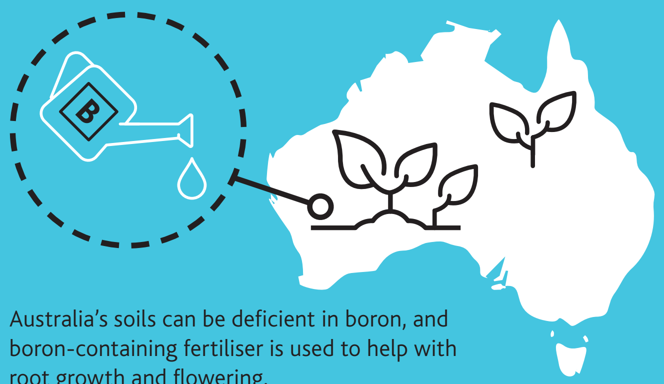
Each time you watch sport on a flatscreen television, or send a message by touching your smartphone screen, give thanks to an unsung hero of the periodic table: boron.

Boron, often wrongly labelled a 'boring' element, plays a versatile role in our lives.

It's the key ingredient in borosilicate glass, which is known for its exceptional resistance to thermal change and chemicals, and its ability to withstand impact. This means glass cookware can go into a hot oven straight from the freezer, and that lab equipment such as beakers and test tubes can withstand corrosion.

Neodymium magnets, in which boron plays a role in the formation of the crystal structure and retaining magnetisation, are among the strongest permanent magnets commercially available. Boron is also used to prepare detergents, buffer solution, insecticides, insulation and semiconductors.



Australia's soils can be deficient in boron, and boron-containing fertiliser is used to help with root growth and flowering.

Although I research boron chemistry for energy conversion and storage, the element has a rich history with many practical applications.

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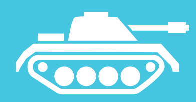
What makes boron so special?

Due to its reactivity, boron naturally exists only in combination with other elements, forming boric acid and inorganic salts known as borates.

One key reason why boron is so versatile is its electron-deficient nature, which means it's very inclined to accept electrons from other elements and easily forms many interesting compounds with both metals and non-metals.

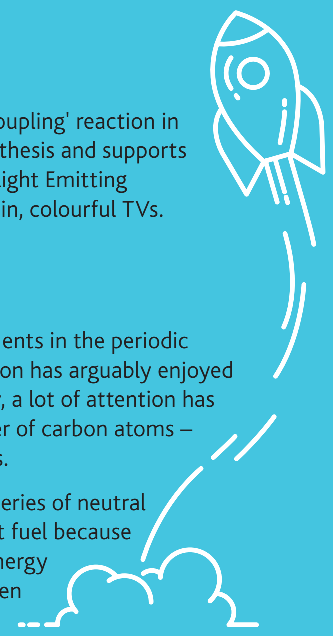


For example, metal borides, compounds formed between metal (M) and boron (B), such as rhenium diboride, have high hardness due to extensive B-B and M-B bonds. There's also boron carbide, which is an extremely hard and light ceramic used in bullet proof vests and tank armour.

Boron-10 (10B), a stable isotope that can be isolated by extensive distillation of volatile boron compounds, has led to Boron Neutron Capture Therapy (BNCT) that treats locally invasive malignant tumours, such as recurrent head and neck cancer.

Notably, the Nobel Prize for Chemistry has been awarded at least three times to scientists working in the field of boron chemistry.

One recent contribution is the 'Suzuki Coupling' reaction in 2010, which revolutionised chemical synthesis and supports product developments such as Organic Light Emitting Display (OLED), which can be used for thin, colourful TVs.



Boron versus carbon

Boron and carbon are neighbouring elements in the periodic table and are similar in many ways. Carbon has arguably enjoyed greater publicity, however. Most recently, a lot of attention has been paid to graphene – one atomic layer of carbon atoms – which has many potential high-tech uses.

Similar to hydrocarbons, boron forms a series of neutral boranes that were once studied as rocket fuel because they produce an enormous amount of energy when reacting with oxygen. But they often proved toxic and too difficult to control.

Elemental boron exists in 16 known 'allotropes' – different forms of the same element. Carbon has two common ones: diamond and graphite.

The difficulty in controlling the formation of desired boron allotropes slows down research. In contrast, carbon materials can be easily prepared and studied.

A pivotal role in energy conversion and storage

It is exciting to see scientists around the globe beavering away in labs, finding new ways to use this plucky little element.

Here are some of the big questions they're tackling:

1 Boron as a source of energy

Some researchers are examining whether we can get energy from boron using aneutronic fusion – a form of fusion power in which negligible amounts of neutrons are released.

2 Boron as an energy carrier

Compounds containing boron, nitrogen and hydrogen can effectively store and transfer hydrogen. This is important because hydrogen is an ideal candidate to store energy produced by wind farm and solar plants.

Sodium difluoro (oxalato) borate, on the other hand, can outperform some commercial compounds as an electrolyte salt for emerging sodium-ion batteries, which could be a great candidate for large-scale energy storage.

3 Boron for heat conservation

Some solar water heating and solar power generation plants are using borosilicate collector tubes to harness reflected radiation from mirrors, so the steam turbines can be driven in a more efficient way.

We have also seen more stringent building standards with respect to heat conservation, promoting the use of borates for fiberglass insulation.

Impressed? Should boron get more of the spotlight? I'm sure we will see boron continue to be a star in our tech-driven society. From fertiliser to OLED screens, it's poised to have a big impact.