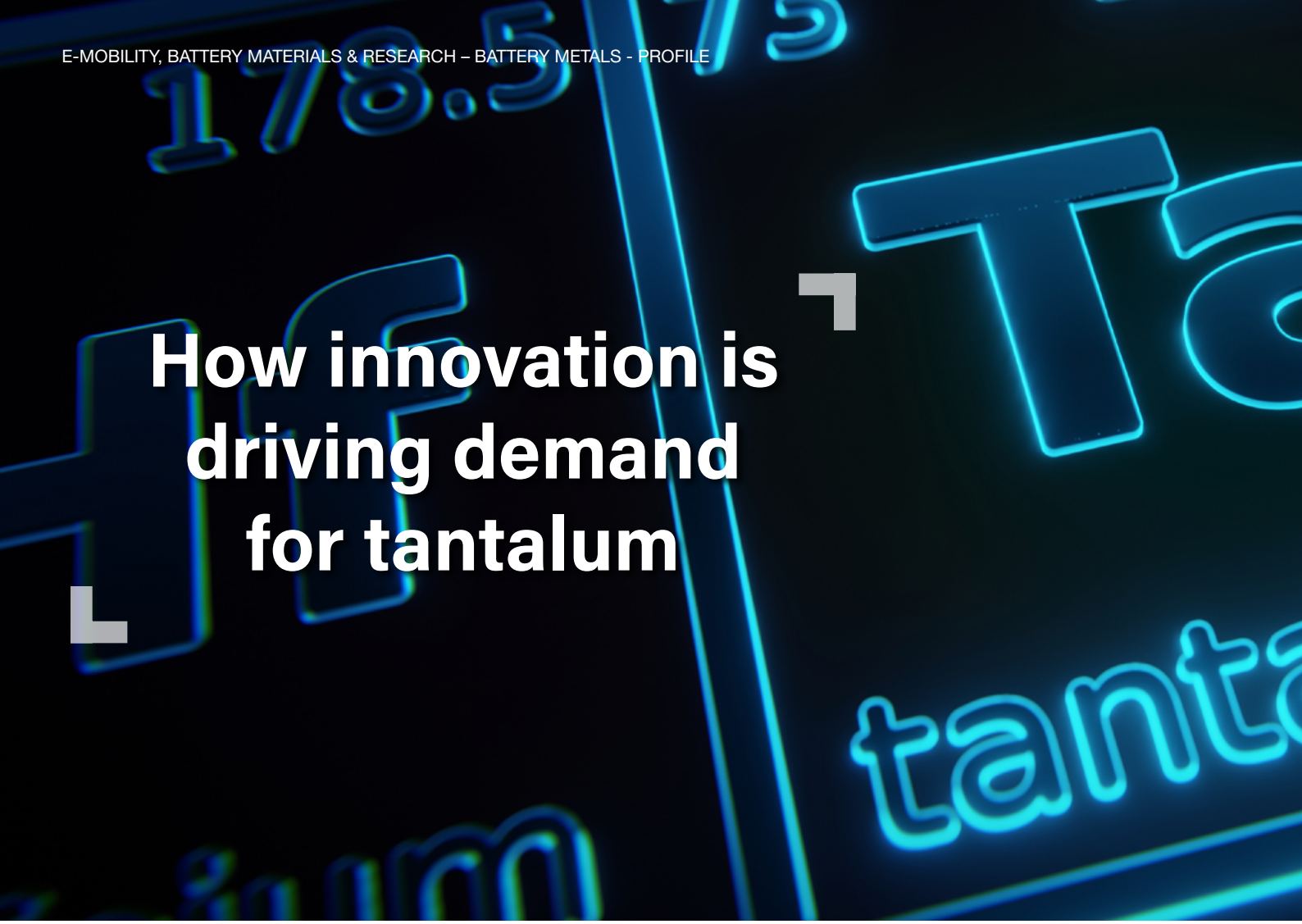

How innovation is driving demand for tantalum

Avalon Advanced Material's Donald Bubar explores the vast capabilities of the technology metal tantalum

Tantalum is a rare, soft-when-pure, blue-grey transition metal that is highly corrosion-resistant. It is part of the refractory metals group, which are widely used as minor components in alloys because of their stability and high melting temperatures, which for tantalum is 3,017°C. Tantalum is widely dispersed in the Earth's crust with an average concentration globally of just 1-2ppm.

The chemical inertness of tantalum makes it a valuable substance for laboratory equipment, and as a substitute for platinum. Its main use today is in tantalum capacitors for electronic equipment including mobile phones, DVD players and computers, as well as in semiconductors and various types of alloys and super-alloys due to its high-temperature performance in engines and gas turbines. Tantalum is now considered a technology-critical element by the European Commission (EC) and is also included on the Critical Minerals Lists of Canada and the USA.

What is tantalum?

Tantalum, often found together with the chemically similar Group 5 element niobium, mainly occurs in the mineral tantalite-columbite (Fe, Mn) $(Ta, Nb)_2 O_6$. It also occurs in some rare earth minerals, including fergusonite (Y,REE) $(Ta,Nb)O_4$ (which occurs at Avalon's Nechalacho REE Project) and samarskite $(Yb,Fe)_2 (Ta,Nb)_2O_8$. Tantalite-columbite is typically found in lithium-caesium-tantalum (LCT) pegmatites. With the rapidly growing demand for lithium battery materials, development of more LCT pegmatites (including Avalon's Separation Rapids Lithium Project) will help increase the supply of tantalum as tantalite can easily be produced as a by-product of lithium mineral recovery.

There continues to be innovation of new applications for tantalum in various new technologies related to aviation and aerospace because of its stability, where it is used in in-flight gas turbines. Tantalum alloys also have applications in medical equipment because it is non-irritating when used for surgical instruments and is totally inert to bodily fluids, making it an ideal material for surgical implants.

Tantalum is becoming more and more in demand as an implant material due to its outstanding bio-compatibility and high degree of ductility and

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corrosion resistance. Tantalum is also used to make porous, high-strength bone implants because human bones have a good affinity for tantalum. Tantalum also has the ability to stimulate bone growth.

Rising demand

Innovation will continue to increase demand for tantalum. Global demand in 2021 was 1,887 tonnes and it is now forecast to grow to at least 2,440 tonnes by 2028, depending on the pace of innovation of new applications. Tantalum prices currently range from $210/kg to $360/kg, depending on whether there is local production of the mineral concentrates and the derivative products.

Demand for tantalum in the automotive industry is likely to accelerate with the transition to electric vehicles where capacitors (or ultracapacitors) can help with energy storage. Similarly, growing demand for various electronics products where energy storage is important, including smartphones and laptop computers as well as in medical applications, will also contribute to growing demand. Tantalum capacitors are being utilised in implantable medical devices and will see increased use in electronic devices designed for health and wellbeing as there continues to be innovation of interesting new products in the electronics industry applicable to medical care.

Tantalum is also used in the production of semiconductors as a thin film diffusion layer where its performance is very reliable. With the most stable thermal, electrical, and mechanical properties for a variety of semiconductor applications and device operating temperatures, tantalum offers the highest purity levels. Tantalum's compatibility with silicon and silicon dioxide for chip production is also a significant benefit.

The application of tantalum in gas turbines takes advantage of its high melting temperature. Tantalum is added to nickel-based superalloys in order to create materials with higher temperature mechanical characteristics, improved corrosion resistance and longer life. In the so-called hot section of the gas turbine engines, which makes up about 50% of the weight, tantalum is a key component of both single crystal and polycrystalline superalloys. Tantalum's function in superalloys, and the way in which it improves their performance, has adapted to many new technologies by creating a new group of alloys.

Canada had one of the original producing tantalum mines, the Tanco Mine in southeastern Manitoba. It was a classic example of a zoned LCT pegmatite that began producing significant quantities of tantalum in 1969. It also became a major producer of caesium when Cabot Corp took control of it in 1993 and Cabot used the caesium to produce caesium formate, a very stable recyclable fluid, used in deep oil well drilling. There has never been much exploration for other LCT pegmatites in Canada but there are many other occurrences of LCT pegmatites now being looked at mainly as lithium battery materials development opportunities that will also contain tantalum. So, the potential for new tantalum production in Canada is growing rapidly.

Acknowledgements

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