The future looks bright for zirconium

The most important metal you never heard of

"Zirconium is yet another example of an obscure critical material with great potential in new technology where China controls the supply chain." – Donald Bubar, President & CEO at Avalon Advanced Materials Inc.

Zirconium is a relatively obscure but important element that is finding increasing application in a range of new technologies. It is most commonly found in zircon ($ZrSiO_4$), an industrial mineral used directly in many high-temperature applications. Zirconium in its many forms is now an essential part of cell phones, nuclear plants, dialysis machines, paint, ceramics and catalytic converters.

Zirconium was discovered in 1789 but it took 35 years to isolate the element. It took another 100 years before a pure zirconium metal was produced. With a high specific gravity, zircon is commonly found with other heavy minerals in deposits of prehistoric beach sands. It is usually a byproduct of mining these sands for titanium. Heavy mineral sand resources are found in several parts of the world with much of the historical production coming from South Africa and Australia. There is another rarer zirconium ore mineral called baddeleyite (Zr02) presently only recovered from an iron ore mine in Russia. As with many technology metals, the challenge of zirconium is in the economic processing of the mineral concentrates, not in mining the resource. Much of this processing is currently being done in China.

The ceramic pigment market was the main early driver for the

development and production of zirconium chemicals of various types. After World War II, the ceramic/refractory industry became interested in zircon and zirconium oxide while the Department of Defense focused on the pure metal of zirconium. The driver behind the need to produce a pure zirconium metal on an industrial scale was to supply the military with alloys of magnesium and zirconium. The second major military market development for pure zirconium metal was for cladding fuel rods for both the nuclear navy reactor as well as for civilian nuclear power stations.

There are at least three things that use zirconium in this photo – the ceramic mug, the cellphone and the wall paint.

Today some of the many applications for different zirconium compounds include kidney dialysis, coated paper (frozen food packaging), pigment coating (Ti02), paint driers, and thixotropic paints (paints that are free-flowing and easy to apply while being brushed on, but quickly reset into a gel). As industry has gained a better understanding of the chemistry, it has been able to move into the growing market of advanced ceramic/oxide applications. Some applications of zirconium ceramics are piezo electrics (spark ignitors, sonar devices, and ultrasonics), thermal barrier coatings (turbine blades), solid electrolytes (oxygen sensors, fuel cells), and catalysts (cracking of petroleum, catalytic convertors).

Demand for zirconium and the appeal of producers will continue to grow, and because of its unique physical and chemical properties it will find application in many new growth technologies, including more efficient and environmentally-friendly clean technologies. It won’t take long before its critical importance is appreciated.