Global growth prospects transformed for titanium, speciality metals and alloys

Industries to benefit from a new greener manufacturing process

Harry Pepper, chief financial officer of Metalysis, discusses the potential global impacts of the innovative FCC Cambridge process for the manufacture of speciality metals and alloys.

For many of the world's biggest industries speciality metals and alloys are a crucial feedstock. Whilst technological advance has been high among the drivers for change and growth in most industries, this has not been the case in the metals industry itself, where change has been traditionally very slow. Now, the application of innovative technology pioneered by Metalysis may be the spark for a transformation, one with potentially far-reaching commercial and environmental benefits.

The refining of titanium offers a good example of just how modest the pace of technological advance has been. The Kroll process (or its variant, the Hunter process) was invented in the 1940s and is commonly used today for refining titanium and, with some modification, other speciality metals including tantalum, niobium and zirconium. Like many older technologies, the Kroll process is neither efficient nor environmentally sustainable. For example, it is hazardous, time-consuming and, depending on feedstocks, yields significant chloride liquors that require re-processing to render safe.

It's against this background that Metalysis has been formed to exploit a new electrochemical reduction technique known as the FFC Cambridge process. At commercial production levels, this presents the realistic prospect of dramatically reduced costs and improved environmental impacts.

The striking feature of the FFC Cambridge process is its simplicity. A metal oxide is placed in a molten salt bath and a current passed between it and a counter electrode. The oxide ions leave the metal oxide and are carried across the salt to the anode, where they evolve as a gas. This leaves the pure metal behind. For most metals, the product can be simply washed and ground to a powder.

As many metals lie in the ground in their oxide state, the FFC Cambridge process has a broad range of applications and, when two or more metal oxides are mixed, the process reduces them directly to an alloy. The technology reach is, therefore, extended across a wide spectrum of alloys.

The simplicity of the FFC process provides Metalysis with an inherent economic cost advantage over existing traditional multiple-stage processes and that translates into both substantial capital as well as operational efficiencies. Equally important, it offers the prospect of significant direct and indirect environmental benefits.

Direct environmental impacts

The FFC Cambridge process requires a lower energy input than conventional processes and does not require the melting of metals. A 2004 study concluded that the FFC Cambridge process would generate approximately half the carbon footprint of conventional routes to titanium metal, equating to a saving of 11kg of CO_2 per kilogramme of titanium produced[1]. Should hydro-electricity and inert anode technology be utilised, Metalysis has the potential to produce metals and alloys with a nil or near-nil carbon footprint.

Among other environmental advantages:

- Metalysis uses one reagent, a salt (that is also spread on the roads during icy periods) and which it intends to recycle. The conventional technologies use hazardous substances such as chlorine gas, liquid sodium and magnesium. These substances and the resultant by-products require expensive and difficult disposal or purification processes that further complicate and increase the environmental impact of conventional manufacturing.
- Metalysis directly produces a product in a powder form, or one that can be lightly ground into a powder. While powder metallurgy may still be in its infancy, it already offers considerable post-processing savings via significantly lower wastage levels.
- The metal powders produced by the FFC process also are expected to be considerably purer than those produced using conventional technologies, thus reducing the need for post-processing purification steps; providing further savings on reactants and energy requirements.

Indirect environmental advantages

Cheaper processes will inevitably lead to greater availability of high-performance, more sustainable materials in everyday applications. Among them:

- A wider use of titanium. Titanium, as strong as steel but 45 per cent lighter, is corrosion-resistant and the ninth most common element on the planet. Its comparative rarity in everyday life is a result of its stability in its oxide form, which makes production both difficult and expensive. As the cost of titanium manufacture falls, its commercial take-up is likely to increase exponentially, providing considerable fuel efficiency savings in all transport markets. Titanium can also be alloyed with iron, aluminium, vanadium, molybdenum, among other elements, to produce strong lightweight alloys.
- Tantalum is used predominantly in high-grade capacitors for the electronics industry. For instance, there are 16 tantalum capacitors in an iPhone and approximately six in a digital camera. Again these parts are extremely expensive to produce. A cheaper, more flexible method of manufacture as offered by the FFC Cambridge process means lower prices, opening up a greater number of markets to small, lightweight capacitors and resultant miniaturisation.

Looking ahead

In the period to 2010, Metalysis plans to launch its first three products into international markets. These are titanium, titanium based alloys (for use in biomedical, petrochemical and other sectors) and tantalum for use in the portable electronics industries. Within a short time, then, the speciality metals and alloys manufacture industry, and the global sectors it serves, may be entering a new phase when commercial interests and environmental impacts are inextricably linked, for the better.

1. Report on the Potential of the FFC Cambridge Process to Reduce Carbon Impact of the Metals Producing Industries 2004. Prepared by Oakdene Hollins, Metalysis and Tungsten Manufacturing Ltd, with support from the Carbon Trust.