Volatility in the rare earth materials

By **Michael Klein** July 19, 2011

markets as an investment opportunity in nanotechnology

Read our article in the Cayman Financial Review Magazine, eversion

There are exciting nanotech approaches to many of the high-growth sectors that presently rely on rare earth materials.

Rare earth materials are fundamental to the manufacture of modern lightweight rechargeable batteries, high-efficiency motors and optical telecommunications equipment. Many analysts have warned that the demand for these materials is rising much faster than available supplies.

Unfortunately these supplies are geographically concentrated in ways that allow political manipulation to magnify the uncertainty in the market for rare earth materials.

For example, in a recent (12/29/2010) Reuters report, "China, which produces about 97 per cent of the global supply of rare earth minerals, cut its export quotas by 35 per cent for the first half of 2011 versus a year ago, saying it wanted to preserve ample reserves."

Worldwide production of important rare earth materials is modest and slow-growing. For example, lanthanum, used in nickel-metal hydride batteries, is limited to 30,000 tons per year; samarium, a primary component in high-strength samarium-cobalt magnets used for electric motors in generators and electric vehicles, is limited to 700 tons per year; erbium, used in optical fibre amplifiers for optical telecommunication networks, is limited to about 500 tons per year.

In all these three cases, projections for use of these materials exceed present worldwide production within a few years. These concerns have led to volatility in the futures markets for these materials, impacting manufacturing costs for the market sectors that depend on these materials.

Nanotechnology to the rescue?

Yes! Most materials rely on the fixed basic properties of the 110 elements in the periodic table, but nanotechnology can create a much longer list of basic building blocks. Through controlled nanofabrication methods, it is possible to build quantum dots and nanowires out of most elements, and also with precise control over the size and shape of the nanostructures. The important new feature is that the properties of the nanostructures depend on the material that they are made from and there can be a very strong dependence on size and shapes. So, by changing the size and shape of nanostructures, we are making new building blocks.

Over modern history, mankind has been very clever at finding ways to squeeze interesting characteristics out of the relatively short list of available elements. Rare Earth-based products, such as Nickel-Metal Hydride rechargeable batteries are excellent examples of this sort of conventional engineering.

However, looking ahead, it is increasingly possible to replace these specialty atoms with engineered nanostructures. Based on these emerging capabilities, scientists and engineers are developing a list of nanotech alternatives to conventional materials engineering. The most important early opportunities for nano-engineered material replacements will be in the applications where the scarcity or cost of the conventional materials is causing problems, such as rare earth-based products.

Rechargeable batteries:

Nickel-Metal Hydride batteries are the most common energy storage technology for portable electronics and electric vehicles, and are dependent on limited supplies of lanthanum, cerium, neodymium and praseodymium. Lithium-ion and lithium-polymer batteries are attractive alternate technologies, and nanotechnology is playing a central role in addressing manufacturing costs, safety, and performance in lithium-based batteries.

Electric motors and generators:
High-strength
samarium-cobalt magnets are key elements in the most efficient electric motors, which are used in wind turbines, electric generators and electric vehicles. The natural arrangement of samarium-cobalt atoms in crystals produces these important magnetic properties. Nanotechnology researchers are looking to produce non-natural arrangements of less scarce materials to generate “rare earth-free” high-strength magnets.

Optical telecommunications:
Erbium-doped glass fibres are used to amplify optical signals in telecommunication networks. Erbium atoms embedded in glass provide the nonlinear optical properties that enable optical amplification. Nano-engineered quantum dots of simple metallic elements can be substituted for the erbium atoms in this application.

In all three of these cases, and many more,
nanotechnology is providing alternate pathways to important materials and device capabilities. Nanotechnology investors should look for opportunities to participate in the development of these alternate pathways, especially in cases like those highlighted above.

Nanotechnology
replacements for rare earths

Investors
should look for breakthroughs in large and small companies providing alternates to the rare earth materials. Development of nano-structured electrodes, nanophosphate materials and nano-engineered
ceramic membranes will enable faster transition to lithium-based batteries.

Nano-engineered magnetic crystals and "rare earth-free" magnets can allow replacement of samarium-cobalt magnets in electric vehicles and generators. Metallic quantum dot-based optical amplifiers can eliminate rare-earth doping of optical fibres. In all of these sectors, nanotechnology can eliminate rare-earth dependence for high-growth applications.

That said, while nanotechnology poses a unique opportunity, it is complex and requires experience and expertise to decipher what is real and what is not. Investors should seek help from advisors with proven nanotechnology expertise.

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Investments has an established track record and commitment to continued focus in the nanotechnology sector, including nanotechnology investment products and two nanotechnology indexes used both as a benchmark and investment tool. Cedrus offers a balanced team of financial and technology experts, who are now poised to guide to new investments in nanotechnology replacements for rare earth materials and other areas within nanotechnology.

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Pinnacle Media Ltd

Cayman Financial Review is the only magazine which promotes the Cayman Islands financial services industry at a local and international level. Produced by Cayman's leading printing and publishing company Pinnacle Media Ltd, the Cayman Financial Review is published quarterly and is distributed in print and online to organisations and associations worldwide as well as at key financial conferences.

Over 30,000 online and targeted printed copies are distributed to clients, their nominated local and international contacts, relevant conference participation lists and a current researched international contact list continuously updated and prepared by Pinnacle Media Ltd. In addition the product has a fully integrated website, a link of which will be sent to 'Top 500' legal, accountant, government, insurance, financial service and hedge fund contact list in United States, United Kingdom, Europe, South East Asia, Dubai and the South Americas.

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