CRITICAL
STRATEGIC METALS

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Your monthly guide to the latest information on the world's strategic metals

New Advances in Graphene

Since the 2010 Nobel Prize in Physics was awarded to Andre Geim and Kostya Novoselov for their discovery of Graphene, the research community and corporations have been busy trying to exploit the properties of this exceptional material. According to many visionaries, graphene is the next big thing since silicon and what's exciting is its unparalleled potential for use in a wide variety of applications.

Graphene is two hundred times stronger than steel and researchers are already studying ways to use it effectively in spacecraft, aircraft, sports equipment and other areas in which carbon fibers have already found an application. Graphene is super-thin and it conducts heat and electricity much better than any other material – better than even copper. Perhaps the most eagerly anticipated use of graphene is in the field of electronics since it was discovered that electrons moved faster in graphene than in other material. Recent experiments have already demonstrated that graphene based transistors can operate at speeds of hundreds of gigahertz. Graphene will revolutionize electronics as we know it today because devices can be constructed smaller and faster than ever.

One of the challenges of using graphene in the electronics industry is that while it is a superb conductor, it is unable to switch off current – something that silicon does very well. Samsung's researchers claim to have cracked this problem by constructing a graphene-silicon barrier that gives graphene the ability to switch off current without losing electron mobility. With this single advancement, a grain-sized computer is suddenly a very real possibility. Recently, a group of Swedish scientists developed a breakthrough transistor technology by combining graphene with silicon carbide. In the coming years we could see graphene being used in LCDs, RF applications, in super capacitors and fast wireless communication devices.

Scientists at the University of Maryland used bilayer graphene to develop an extra-sensitive photodetector. This temperature-sensitive device was found to be a thousand times faster than currently known technologies, besides having the ability to recognize a broad range of light energies. In the future we can expect to see graphene used in body scanners and biochemical weapons detectors.

Recently, in a significant development, researchers not only managed to use graphene to get lithium ion batteries to charge ten times faster, but also increased the battery's charging capacity. Another team was able to achieve a similar feat by using graphene to increase the charging capacity and speed of a Nickel-iron battery.

The high conductivity and water repelling properties of graphene could go a long way in protecting and increasing the life of iron and steel structures. Again, because of its high conductivity, graphene could be used to build economical cooling devices that can cool up to 25% faster than copper. Nanoporous graphene membranes could provide an affordable desalination solution that can effectively end the world's drinking water problem and membranes made of graphene oxide could be used to distil alcohol.

Most recently, scientists discovered that graphene, which is made of very thin sheets of carbon just 1 atom thick, can actually mend itself. This opens up immense possibilities because it not only provides a way to drill through graphene, but it also suggests the possibility of growing graphene into new shapes.

With all this research yielding amazing results, work on the economical mass production of graphene has already gained momentum. Graphene based products are expected to hit the market by around 2015 and the value of the graphene market could reach unimaginable heights as early as 2020.

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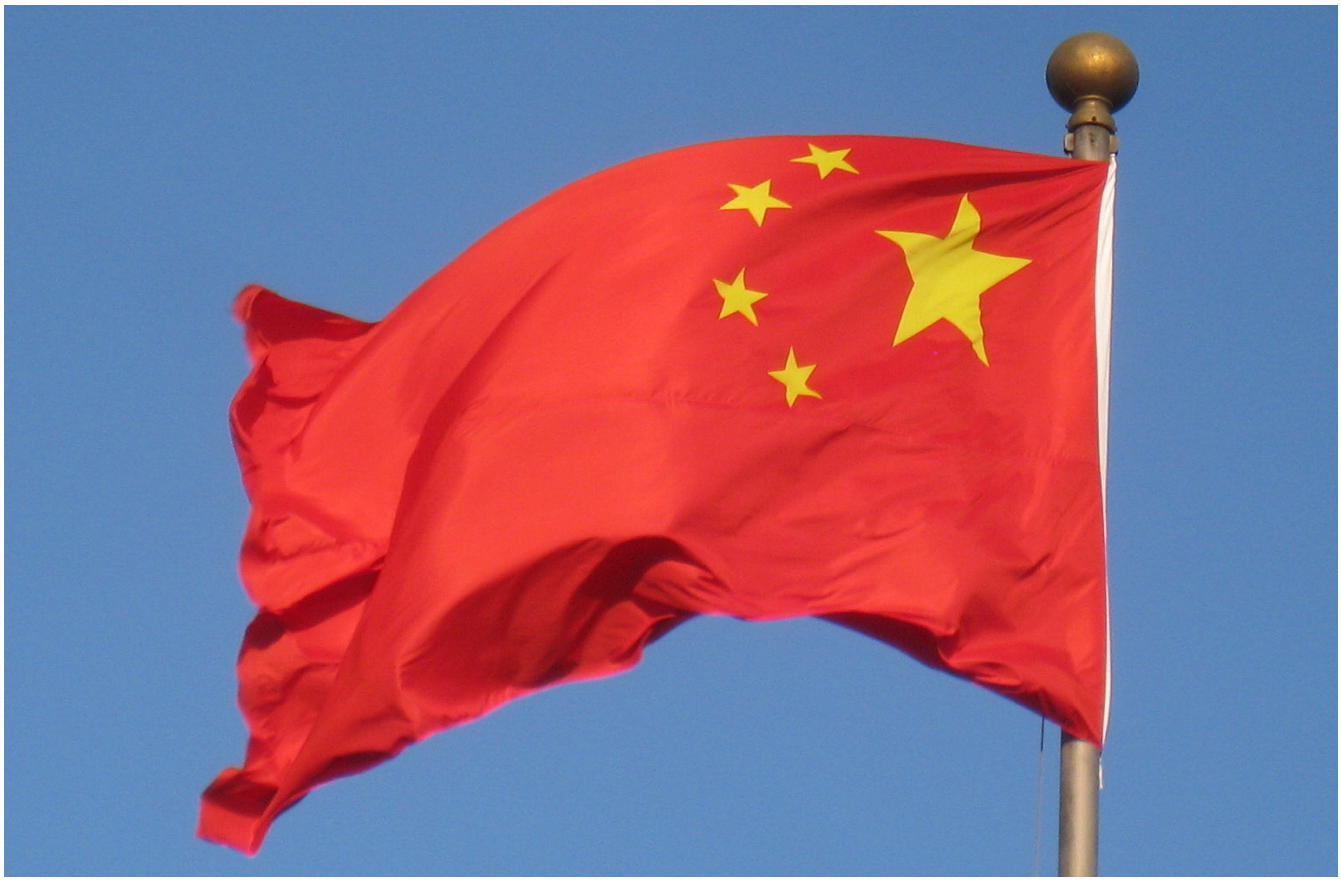
China's Great Rare Earth Reversal



From being the largest producer and exporter of rare earths, China is zooming towards the distinction of becoming the largest consumer of rare earths. With the growth of domestic high-tech industries, increased spending on defense technologies and demand for producing green energy, China is fast becoming a voracious consumer of rare earth materials. According to the U.S. Geological Survey, China's consumption of rare earth elements quadrupled from 19,000 metric tons in 2000 to 73,000 metric tons in 2009. Almost 30% of

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China's rare earths consumption has been primarily used in producing magnets.

In recent times, Chinese rare earth exports have fallen due to increased domestic demand and the government's move to cap rare earth exports with quotas, citing environment protection and conservation of natural resources. According to a recent news report, China has cut rare earth mining permits by half in order to consolidate the industry and create bigger rare earth producing companies.

Perceived as muscle flexing and market manipulation, China's move to cap rare earth exports and reduce production triggered off a price rise as well as panic in certain quarters. The situation however, has given a big boost to new rare earth exploration projects outside China and a slew of announcements for joint exploration and production of rare earth materials.

China's domestic consumption of rare earths is expected to grow by 10 percent each year in the coming years. Increased domestic consumption combined with the cut in mining permits has set the stage for China to become a net importer of certain rare earths by 2014. While international rare earth producers are already positioning themselves to take advantage of this situation, it must be noted that China has a considerable stockpile of rare earths and export restrictions will only add to this inventory, thereby creating a shortfall in the market in the near term and driving up prices even further.

Since last year, there have been reports that China is actively spending huge amounts of money to buy up domestically mined rare earths to build a national stockpile. There are also indications that they are specifically targeting certain heavy rare earths. Chinese authorities have recently confirmed reports of establishing a spot trading platform for rare earths in August, 2012. This together with the national stockpiling exercise will give China a greater control on the rare earth market.

Another important aspect is that China is methodically establishing itself as a globally dominant force in the production of critically important components such as magnets, hydrogen storage cells, luminescent materials and more. Rare earths are the raw materials for all these products. More importantly some of the major manufacturers who use rare earths as raw materials have already moved their facilities to China. Export curbs and inducements by the government have encouraged international companies to set up shop in China.

Today China produces over 80% of the world's magnets and is set to continue growing this industry. Satellites, renewable energy, medical equipment and drilling equipment for natural gas are just some of the applications of magnets. Chinese domestic high-tech industries, the largest consumers of rare earths, are set to play a dominant global role in the coming years. As some analysts have pointed out, China's coking coal sector offers a great insight into how China curbed the export of coking coal to feed its own domestic steel mills. The might of the Chinese steel industry is a testimony to this strategy.

China's strategy of reducing rare earths exports, cleaning up its mining industry and addressing environmental concerns, while pursuing gains in domestic high-tech manufacturing is all about maximizing the returns on its natural resources. In hindsight, dominance over the world's rare earths market gave China sufficient time to establish its supply chain. So its tilt towards rare earths imports should set the alarm bells ringing, if they haven't already, in many downstream manufacturing industries.