

15 rare earth elements, scandium and yttrium



Lanthanum - High quality camera and telescope lenses; and as a cathode in nickel metal hydride rechargeable batteries. The nickel metal hydride batteries in each Toyota Prius hybrid car contains around 4.5 kilograms of lanthanum.



Cerium - Cerium oxide powders are used for polishing high quality optical surfaces; and as a catalytic converter to reduce carbon monoxide emissions. Cerium is also used in phosphors for color televisions and fluorescent lighting.



Praseodymium - As an ingredient in high-power magnets; an alloy in high-strength metals used in aircraft engines; carbon-arc lighting use by the motion picture industry; and to yellow coloring for glass, enamels and ceramics.



Neodymium - High-power permanent magnets in computers, cell phones, medical imaging equipment, electric car and other motors, wind turbines and audio systems; crystal in lasers used to treat skin cancer and for hair removal.



Promethium - Extremely rare and instable in nature. Atomic promethium batteries are used in pacemakers, guided missiles and radios. Due to this element's radioactive decay, electricity can be produced from the light given off by a promethium phosphor.



Samarium - Highly resistant to demagnetization, even at high temperatures, samarium-cobalt magnets are used in precision-guided weapons. These magnets are also used in headphones, quartz watches, camera shutters and electric guitar pickups.



Europium - Widely used to create blue and red phosphors in televisions and computer monitors; white light in fluorescent bulbs; and anti-forgery marks on Euros. Quantum memory chips made with europium can store data for days.



Gadolinium - Small amounts of gadolinium are used to improve heat and oxidation resistance in iron and chromium alloys. This REE is also used as green phosphor in color televisions. Gadolinium yttrium garnets are used in microwaves and lasers.



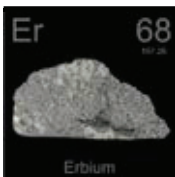
Terbium - Magnets for high-temperature applications such as electric vehicles and wind turbines; and a green phosphor used in televisions and other devices. Terbium green is among three colors used for trichromatic lighting technology.



Dysprosium - Improves durability and reduces weight of magnets in electric vehicle motors and wind turbine generators. It is estimated that each EV has roughly 100 grams of dysprosium, or about one metric ton per 10,000 cars.



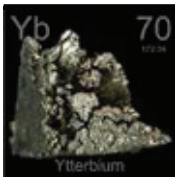
Holmium - Has the highest magnetic strength of any element, which is used to create the strongest artificial magnetic fields; holmium-doped garnets are used in lasers used for medical, dental, and fiber-optic applications.



Erbium - Used with vanadium to increase the pliability of metals; medical lasers for tattoo removal and other skin resurfacing; nuclear reactor control rods; and pink coloring agent in glazes and glasses.



Thulium - High precision lasers used for surgery. Thulium that has been bombarded in a nuclear reactor is used as a radiation source for portable X-ray diagnostics. Euro banknotes also take advantage of thulium's blue fluorescence under ultraviolet light as counterfeit prevention.



Ytterbium - Being studied as an alloy to improve the strength and other mechanical properties of stainless steel. Used in stress gauges to monitor ground deformations caused by earthquakes or underground explosions; and as a radiation source for a portable X-ray machine where electricity is unavailable.



Lutetium - Has few commercial applications, due to being expensive and rarer than most REEs. It is, however, used as catalysts in petroleum cracking in refineries. Research indicates that lutetium-ion atomic clocks could provide greater accuracy than any existing atomic clock.



Scandium - Certain aluminum-scandium alloys are strong as titanium, light as aluminum, and hard as ceramic. These alloys are used in aerospace components and high-end sports equipment such as bicycle frames and baseball bats. Metal-halide lamps and lasers are other uses.



Yttrium - Yttria, an oxide used to create the red component of color in television picture tubes, is the largest use of yttrium. This element is also the ingredient of a large variety of synthetic garnets used as microwave filters, lasers, jewelry and white LEDs. An isotope of yttrium is used to treat cancer.

