Uses of Beryllium

Because of its unmatched combination of qualities, beryllium has become an increasingly important material for a wide range of commercial and governmental applications.

Communications

Beryllium is used in the manufacture of telecommunications infrastructure equipment, computers and cellular phones, thereby helping people around the world to keep in touch.

People worldwide keep in touch, work more productively and relay vital information during emergencies with cellular phones and computers manufactured with beryllium-containing materials.

Connecting continents. On the ocean floor, copper beryllium housings protect the electronics that allow fiber optic cables to function flawlessly. These barrel-like housings, which resist highly corrosive sea water and extreme pressures, show little deterioration even after decades of service.

Enabling multi-function devices. On the ground and through the air, society stays connected thanks to beryllium and beryllium-containing materials:

- Battery contacts and electronic connectors in cell phones and portable electronics are made with copper beryllium alloys. The material meets stringent requirements for durability, weight savings, electrical conductivity and corrosion resistance in all extremes of weather and temperature.
- Copper beryllium alloys provide "spring memory" that ensures continuous, fatigue-free electrical connections through constant use, openings and closings, vibrations and accidental drops.
- The low electrical resistance and high thermal conductivity of beryllium-containing materials supports the convergence and miniaturization of multiple functions – phone, camera, MP3 player – into a single, lightweight, compact device.

Advancing digital technology. High-performance processors pack more and denser layers of high-frequency circuits into smaller packages. That means higher processing speeds and better performance for personal computers, routers, and the internet, as well as radars, avionics, and defense systems. The exceptional thermal conductivity and insulating properties of beryllia ceramic protect these systems from the potentially crippling effects of intense heat generation. With thermal conductivity up to 10 times greater than that of alumina ceramic, beryllia ceramics remain the insulators of choice for such high-frequency circuits.

Medicine

Advances in imaging equipment, diagnostics and laser medicine have been enabled by the strength and stability of this versatile metal.

The special properties of beryllium are essential to medical technologies that save and enhance lives.

Improving imaging. Because it is strong, stable, can handle elevated levels of heat resistance and is highly transparent to x-rays, beryllium, in thin foil form, has long been critical to the operation of medical and scientific x-ray equipment. Beryllium foil provides the window through which tissue-penetrating x-rays are focused, while maintaining the vacuum inside the x-ray tube generator.

Beryllium foil remains indispensible for high-resolution medical radiography, including CT scanning and mammography. Beryllium in newer generation mammography equipment enables a lower radiation dose scan with significantly finer tumor resolution, enabling breast cancer detection at its early,

most treatable stages.

As imaging technology advances, beryllium continues to meet the need for x-ray tube windows with greater strength, stability, heat resistance and x-ray transparency.

Miniaturizing optical lasers. Medical lasers made with beryllia ceramics help ophthalmologists to restore or improve eyesight for millions. Beryllia ceramic is the only material that offers the thermal conductivity, strength and dielectric properties required to contain and control these tiny, high-powered gas laser bores.

Simplifying surgery. Copper beryllium connectors transmit precise electrical signals to delicate surgical instruments and monitoring devices used in the newest, non-invasive surgical techniques. Such techniques reduce patient trauma and infection risk, while speeding the process of healing and recovery.

Analyzing blood. Beryllium is also used in components of the analytical equipment used to analyze blood for HIV and other diseases, offering the precision and reliability that doctors and patients demand.

Transportation

Used in automobile airbags and electronic braking systems, weather forecasting satellites, chemical detection, fire suppression sprinkler systems and emergency rescue equipment, beryllium helps to keep us safe.

Ready for use in a split second. Beryllium's capabilities are used in airbags, fire sprinkler systems, aircraft bushings and bearings, power steering and electronic control systems, anti-lock brakes, undersea earthquake and tsunami detection monitors, air traffic control radar and weather forecasting satellites. Beryllium's strength, fatigue resistance and corrosion resistance can help to save lives and protect property in a fraction of a second.

Reliable for decades. Critical washers, made of nickel beryllium alloys, enable overhead sprinkler heads to deliver full water pressure in the event of fire, while maintaining a leak-tight seal for years of inactivity. Such reliability ensures that thousands of sprinkler systems, installed over many decades, continue to stand by.

Spark-free. The non-sparking and non-magnetic properties of beryllium help protect oil and gas exploration crews (and other people working around combustible gases) from risk of accidental explosions from sparks generated by tooling and equipment.

Ensuring child safety. Beryllium x-ray windows in hand-held analytical devices allow retailers and day care centers to ensure toys are free of lead and other harmful heavy metals.

Breathing easy. Beryllium alloy components ensure the reliability of pressure controls that deliver air from lightweight breathing systems used by firefighters and rescue crews.

Discovery

From heat shields that protected NASA's Mercury astronauts, to the orbital telescopes of tomorrow, beryllium materials have had a front seat in our nation's extraordinary exploration of space.

BERYLLIUM MAINTAINS A LEGENDARY ROLE IN CONSTANT PURSUIT OF KNOWLEDGE.

From NASA's earliest days, when beryllium heat shields protected Mercury spacecraft during re-entry, scientists, designers, and engineers continue to depend on this stiff, lightweight and versatile material to meet their most demanding challenges.

Orbiting the earth. Beryllium serves on current NASA vehicles including the Space Shuttle, where it adds strength, dissipates heat and lightens weight in window frames and door systems. Beryllium components also fly in the Spitzer Space Telescope.

Roving the Red Planet. Two Mars Rover vehicles, Spirit and Opportunity, have far exceeded original expectations. Aluminum beryllium components helped protect the rovers on their landings, and then served again to unfold their drive-off ramps. Aluminum beryllium parts used in the Rovers' rock exploration tools have helped our understanding of the planet.

Fixing Hubble. When the Hubble space telescope could not see clearly, its new "corrective lenses" were mounted in beryllium fixtures that met the requirements for lower weight, high stiffness and resistance to dimensional distortions brought on by extreme temperatures.

Looking ahead. The next-generation James Webb Space Telescope, scheduled to deploy in 2014, will depend on a 6.5 meter beryllium mirror to see objects 200 times fainter than visible before. Such mirrors must combine high stiffness and lightweight with an extraordinarily smooth, precise and defect-free surface. And, they must retain their visual quality for decades in deep space, where temperatures never exceed minus 253 degrees Centigrade.

Recreating the conditions after the "Big Bang". Scientists are utilizing beryllium components in earth-based particle accelerators to ensure high-energy collisions of subatomic particles, recreating the conditions that could provide clues as to how the universe was formed. In the European Organization for Nuclear Research's (CERN) $10 billion Large Hadron Collider underground near Geneva, Switzerland, beryllium beam pipes surround the collision regions where experiments will be conducted.

Oil, Gas & Alternative Energy

Beryllium is in wide use in the energy field to extract oil and gas, and has a big role in helping to find tomorrow's clean and affordable energy sources.

Beryllium and beryllium-containing materials lower the cost of oil and gas exploration on land and in deep water. They're also helping lead the way to new and affordable sources of traditional fossil-based fuels, and increasingly, to exciting alternative energy sources.

Helping stop the leaking during the Oil Spills.

Copper beryllium materials played an indispensible role in capping the Macondo Well in the Gulf of Mexico oil spill disaster.

Due to the material's incredible strength, resilience to stress and ability to slip over other materials without galling, copper beryllium clamps were used to securely fasten the capping stack to the damaged well pipe.

In addition, only copper beryllium has the strength, flexibility and transparency to magnetic fields that allowed the sensitive equipment to locate the blown out well and determine the precise location of the drill bit for the relief well bore.

Supporting Oil Exploration and Production

Alloys containing beryllium are used to extend the reach and effectiveness of oil and gas drilling equipment. Exploration crews depend on beryllium's non-sparking properties to reduce explosion and fire risks.

New directional drilling techniques, developed in the late 1990s, are helping rig crews reach more remote deposits. Yet, they depend on material that can operate reliably with electrical controls far from the drill head under high stress and elevated temperatures to prevent very costly drilling failure. Non-sparking copper beryllium alloy materials, which combine strength, conductivity, durability, and corrosion resistance, help make this possible.

Beryllium-containing x-ray tubes and detectors monitor the well flow rates of water and oil and gas as these materials are brought to the surface.

Capturing Solar's Potential

Alloys containing beryllium provide the thermal management, conductivity, and strength required in the electrical terminals that join the components of thin-film solar panels.

The superior thermal properties of beryllia ceramic allow concentrator photovoltaic (CPV) solar cells to operate at very high solar concentrations — 1,000 times the intensity of the sun—yet keep vulnerable electronics in the CPV cool enough to operate efficiently. This technology is already delivering electricity to power grids in areas throughout the world with abundant sunshine.

Containing Nuclear Fusion

Fusion reactors employ beryllium for its neutron reflecting and moderating properties, as well as its ability to withstand the extraordinarily high temperatures associated with fusion energy. Fusion holds promise for delivering virtually unlimited sources of energy with virtually no greenhouse gases and little nuclear waste compared to traditional nuclear fission reactors.

Beryllium has been qualified for use in the International Thermonuclear Experimental Reactor (ITER) project, a partnership that will operate the world's largest prototype fusion reactor. Beryllium components are already proven in the smaller Joint European Torus (JET) experimental reactor located in England.

Defense & Security

The armed forces of the world rely on beryllium – a critical component of weapons, guidance, surveillance and reconnaissance systems.

2.6 Defense & Security

Defense & Security

Beryllium is crucial to the defense of the nation, the protection of our allies and the security of the homeland. The U.S. Department of Defense (DoD) reported in 2008 that of all the metals used in its systems, only high purity beryllium was deemed "critical." DoD stated that beryllium is "essential for important defense systems and unique in the function it performs." NATO and the EU have presented similar conclusions.

A major application for copper beryllium alloys in aerospace is as the female connector terminals in the thousands of electronic and electrical connectors used in every aircraft, which are subject to intense vibration and stresses, yet must perform reliably over the 30 – 40 year lifespan of an aircraft.

Systems. Military systems depend heavily on electronics for navigation, target acquisition and firing. In critical situations and equipment, stiff, lightweight beryllium components ensure precise operation under extreme conditions.

In military fighter jets, pure beryllium saves weight critical to speed and maneuverability, while also ensuring razor-sharp targeting and strike capabilities. Copper beryllium is used for electrical connectors, fasteners and structural components in fixed-wing aircraft and fighters including the:

- F-35 Lightning II Joint Strike Fighter
- F-22 Raptor
- F-18 Super Hornet
- F-16 Fighting Falcon, and,
- F-15 Strike Eagle.
- Eurofighter
- BAE Tornado
- Dassualt Rafael

In optical systems of military helicopters, beryllium components are designed into enhanced surveillance and targeting systems that help keep crews safe.

The nation's unmanned aerial systems count on beryllium optical systems for real-time imagery and targeting on surveillance and reconnaissance flights.

For battle tanks on the move, stiff beryllium mirrors dampen vibration and provide a jitter-free optical path for targeting and firing controls.

Beryllium is also integral to the airborne equipment used to detect and destroy improvised explosive devices (IED) and tactical mines.

In emerging guided missile defense systems, beryllium is critical to assure a first line of defense in directing, targeting and ultimately destroying missile threats.

U.S. military satellites rely on beryllium metal for structural and dimensional stability, as well as reliability, in the electrical systems that deliver reliable intelligence from space.

Command and Control Communications. Military communications depend on copper beryllium alloys in network hubs, switches and routers. The strength, electrical and thermal conductivity of this material ensures reliability while maximizing signal speed and bandwidth.

Homeland Security. Behind the scenes at airports, ports, border stations and other public assets, beryllium and beryllium-containing materials support surveillance, inspection and countermeasures vital to security. At countless locations, beryllium components operate in the x-ray machines,

sorting equipment and scanners used to inspect baggage and cargo for illegal and dangerous substances.

Transportation

Beryllium alloys are used in automobile components and airplane equipment to ensure the reliable operation of vital equipment and to enhance fuel efficiency.

Beryllium helps get us from here to there.

Benefiting drivers everywhere: Today's cars and trucks include technologies and innovations that make driving safer, as well as more comfortable and fuel efficient.

Lightweight beryllium alloy connectors are used throughout the electrical systems of cars and trucks for their reliability and to improve vehicle fuel efficiency. Copper beryllium components are found in traction controls, transmissions, electric motors, anti-lock braking and fuel injection systems. Further, copper beryllium electrical connectors are used in electrically assisted steering systems that are replacing older, heavier hydraulic and electromechanical systems.

In commercial aircraft, landing gear bushings and bearings made from copper beryllium handle great compressive and wear forces despite corrosive atmospheres and exposure to wide ranges of temperature. The higher strength of copper beryllium compared to alternative bronze landing gear materials allows the bearings to be made smaller and lighter. These weight savings, in turn, make planes more fuel efficient which results in reduced exhaust emissions.

Beryllium is a crucial component of the electronic safety and navigation technology, including Global Positioning Systems (GPS) used for air-traffic control and air route surveillance.