HIGH PERFORMANCE SOLUTIONS FOR THE LED INDUSTRY

ELMET
TECHNOLOGIES

OUR COMMITMENT TO ENGINEERING EXCELLENCE

Elmet Technologies delivers superior quality with material consistency and product reliability. Elmet Technologies achieves world class quality through continuous research of new products, development of engineering solutions, and applying them in Elmet Technologies manufacturing environment to deliver premium products for the most challenging applications.

Nearly 100 years of powder metallurgical experience is the cornerstone of Elmet Technologies success in producing advanced technology metals for fast growing industries including aerospace, chemical processing, electronics, industrial, medical, and energy. As one of the world's leading suppliers of molybdenum, tungsten, niobium, and their alloys, Elmet Technologies is at the forefront of creating solutions with next-generation materials and fabricating engineered components for a diverse spectrum of markets.

> Product Quality and Service
> Manufacturing Excellence
> Research and Development
> Reclamation and Recycling






STRATEGIC ADVANTAGES OF WORKING WITH ELMET TECHNOLOGIES

Elmet Technologies understands market trends and the latest cutting-edge technologies providing us the opportunity to create value-added solutions for complex applications. In addition, our robust and sustainable vertically integrated supply chain enables us to deliver high performance materials and products seamlessly to the marketplace.

A recognized leader in refractory metal technology, Elmet Technologies knowledge and technical expertise benefit customers through joint collaborations with our dedicated team of research engineers. This collaborative effort facilitates new and improved product designs through a study of the product's life-cycle. Extensive in-house state-of-the-art laboratory facilities with the latest in analytical tools, testing equipment, modeling and simulation software assist engineers in evaluating product performance. Innovative material solutions provide texture control thus enhancing the uniformity and performance consistency.

LED – THE NEXT GENERATION IN SOLID STATE LIGHTING

Solid state lighting has seen rapid adoption in the electronics industry as backlighting for flat panel display applications, and the automotive industry. The next wave of innovation will be in the general lighting industry for interior designs, architectural, municipal, and home lighting, which will drive tremendous growth in white LEDs.

The most attractive features of LEDs are their high energy efficiency, miniature size, environmentally friendly and longer service life. Elmet Technologies engineered product solutions support the LED market with products critical to the success of the sapphire crystal-growing industry's high temperature furnaces. LED cutting-edge technology requires refractory materials – molybdenum and tungsten that do not contaminate molten alumina during the crystal growth process.

Elmet Technologies molybdenum crucibles for sapphire crystal growth are pressed, sintered, and formed to a customer'srequired specification. The tungsten crucibles are pressed, sintered, and precision machined to achieve both the shape andrequired surface finish needed for easier release of the sapphire boule from the crucible at the end of its growth cycle.






SAPPHIRE CRYSTAL GROWTH IN HIGH TEMPERATURE FURNACES

The furnace industry has seen remarkable growth in the production of custom-made, high temperature vacuum or argon

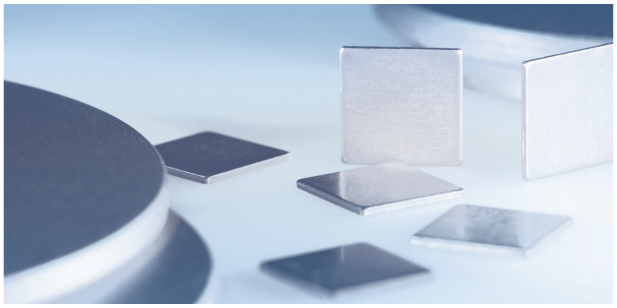
atmosphere furnaces for growing sapphire crystals used in the production of LEDs. These furnaces have unique and demanding hot zone designs for melting alumina in crucibles for precise, highly controlled crystal growth.

Whether by KY, EFG, CZ, or HEM-like methods (GTAT, CHES, and VHGF), Elmet Technologies is well versed in these different sapphire crystal growth methods and supplies engineered product solutions for all technology platforms.

The hot zones in sapphire growing furnaces use Elmet Technologies' molybdenum and tungsten products for furnace components and fixtures. These high temperature materials are characterized by their high thermal and electrical conductivity, low coefficient of thermal expansion, and excellent strength and stability at temperatures above 2000 °C.

Customer specific furnace components and fixtures for high temperature furnaces are uniquely designed and supplied by Elmet Technologies. We machine and fabricate products from molybdenum and tungsten rod, plate, sheet, and foil:

> Hot Seed Holders
> Hot Zones
> Heating Element Materials
> Other Support Components



CONTRIBUTING TO THE LED MANUFACTURING PROCESS

Beyond the critical sapphire growth process, Elmet Technologies offers engineered product solutions for all the other critical process steps in the manufacturing of LEDs.

In the production of phosphors, Elmet Technologies' molybdenum and tungsten crucibles and boats are either pressed and sintered, or made from formed flat rolled material. Moreover, Elmet Technologies' hot zones and furnace components are uniquely designed for phosphor production furnaces and are machined or fabricated to meet specific temperature requirements.

MOCVD equipment plays an important role in the LED manufacturing process. Elmet Technologies' product solutions are fabricated from molybdenum and tungsten materials for complex assembly configurations:

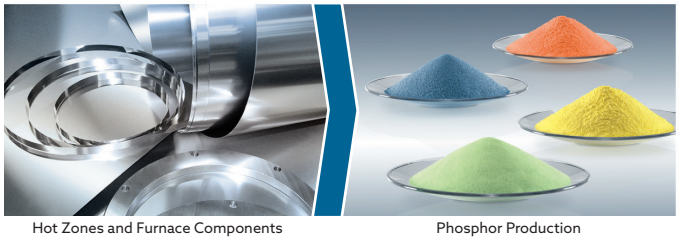
> Collector rings
> Heaters
> Wafer carriers
> Heat sinks

Additionally, we offer molybdenum and Mo-Cu clads materials for base plates and heat spreaders for heat dissipation in LED devices.

Elmet Technologies' engineered components and fabricated products manufactured from molybdenum, tungsten, and theiralloys are used in products for LED applications:

Crucibles and Hot Zones | Sapphire Crystal and Wafers

Substrate for Heat Sinks | Heat Dissipation



Hot Zones and Furnace Components | Phosphor Production

Substrate for Heat Sinks | LED Lamp

ELMET TECHNOLOGIES' PRODUCTS FOR THE LED MARKET

ELMET TECHNOLOGIES SOLUTIONS MATERIALS	ELMET TECHNOLOGIES SOLUTIONS PRODUCTS	END PRODUCT	APPLICATIONS
Mo, W, Mo-La, Mo-W	> Crucibles > Hot Zones > Furnace Components	Crystal Growth Furnaces	Sapphire Crystal Growth
Mo, W	> Collector Ring > Heater > Wafer Carriers > Heat Sinks	MOCVD Equipment	Epitaxial Growth
Mo, W, Mo-La, Mo-W	> Crucibles > Hot Zones > Furnace Components	Furnaces	Phosphor Production
Mo, Mo-Cu	> Base Plates > Heat Spreaders	LED Devices	Heat Dissipation

ELMET TECHNOLOGIES' SECURE MATERIAL SUPPLY CHAIN

Elmet Technologies' Responsible Supply Chain Management System (RSCM) contributes to its reliable and secure supply chain through the procurement of raw materials that ensures efficient and competitive purchasing. RSCM helps to avoid sourcing from conflict regions in the world or from suppliers that do not act in line with environmental and social sustainability. The RSCM system fulfills all requirements of a management system standard required by ISO and has been confirmed by the external auditor, Bureau Veritas.

Elmet Technologies is one of the first companies to pass a second consecutive audit under the Conflict-Free Smelter (CFS) Validation Program introduced in 2010. The program, created and driven by the electronics industry, is being recognized and adapted by many metal industries determined to eliminate unethical sources of raw material from their supply chains. The term "conflict minerals" applies to minerals (including tantalum, tin, tungsten and gold) that have originated in conflict regions where production and trade is closely connected with ongoing abuse of human rights.

In addition to the securing a conflict-free raw material supply chain, Elmet Technologies reclaims spent materials for our customers. A recognized leader in Green Technology, Elmet Technologies is a founding member of the Center for Resource Recovery and Recycling (CR3) coalition. Elmet Technologies was also awarded the Sony "Green Partner" certification, one of the best established programs of its kind, and is a gold standard of the electronics industry. Elmet Technologies' treats sound environmental standards, robust supply chain, energy efficiency and recycling as foundational pieces of our strategy.

ELMET TECHNOLOGIES

ELMET TECHNOLOGIES
1560 Lisbon Street • Lewiston, Maine 04240

P +1.207.333.6100

sales@elmettech.com
www.elmettechnologies.com