

GALLIUM

(Data in kilograms of gallium content, unless otherwise noted)

Domestic Production and Use: No domestic primary gallium recovery was reported in 2002. Two companies in Oklahoma and Utah recovered and refined gallium from scrap and impure gallium metal. Imports of gallium, which supplied most of U.S. gallium consumption, were valued at about \$6 million, most of which was low-purity material. Gallium arsenide (GaAs) components represented about 98% of domestic gallium consumption. About 34% of the gallium consumed was used in optoelectronic devices, which include light-emitting diodes (LEDs), laser diodes, photodetectors, and solar cells. Integrated circuits represented 65% of gallium demand. The remaining 1% was used in research and development, specialty alloys, and other applications. Optoelectronic devices were used in areas such as aerospace, consumer goods, industrial components, medical equipment, and telecommunications. Integrated circuits were used in defense applications, high-performance computers, and telecommunications.

<u>Salient Statistics—United States:</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>	<u>2002^e</u>
Production, primary	—	—	—	—	—
Imports for consumption	26,300	24,100	39,400	27,100	21,000
Exports	NA	NA	NA	NA	NA
Consumption:					
Reported	26,900	29,800	39,900	27,700	21,000
Apparent	NA	NA	NA	NA	NA
Price, yearend, dollars per kilogram, 99.99999%-pure	595	640	640	640	¹ 550
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, refinery, number ^e	20	20	20	20	20
Net import reliance ² as a percentage of apparent consumption	NA	NA	NA	NA	NA

Recycling: Old scrap, none. Substantial quantities of new scrap generated in the manufacture of GaAs-based devices were reprocessed.

Import Sources (1998-2001): France, 44%; Kazakhstan, 16%; Russia, 12%; China, 8%; and other, 20%.

<u>Tariff:</u>	<u>Item</u>	<u>Number</u>	<u>Normal Trade Relations</u>
			<u>12/31/02</u>
	Gallium metal	8112.92.1000	3.0% ad val.
	Gallium arsenide wafers, undoped	2851.00.0010	2.8% ad val.
	Gallium arsenide wafers, doped	3818.00.0010	Free.

Depletion Allowance: Not applicable.

Government Stockpile: None.

Events, Trends, and Issues: One of the two refiners in the United States announced that it would exit the gallium business because of a slump in demand by the telecommunications industry. The Oklahoma firm said that it would liquidate its remaining inventory before the end of 2002. This leaves the United States with only one gallium refiner, located in Utah.

Imports continued to supply almost all U.S. demand for gallium and decreased from those in 2001 because of the continued slowdown in the wireless communications industry. Using partial-year data, China, France, and Russia were the principal U.S. gallium suppliers in 2002. Through July, China had supplied nearly 90% of total imports.

Gallium prices remained lower throughout the year because of the decreased demand. The price of low-purity gallium from China was estimated to be about \$250 per kilogram at midyear, and prices for high-purity gallium were estimated to be between \$400 and \$500 per kilogram.

GALLIUM

Analysts continue to predict significant growth in wireless mobile handset applications, even though demand in 2002 was significantly lower than originally forecast. If demand increases, the main growth driver would be existing subscribers replacing handsets to gain new features and services, such as color screens and data capability. Many of these new platforms are more complex and require additional GaAs content per phone. Despite forecasts of market growth, several companies were consolidating, reducing, or eliminating their GaAs production facilities. Research and development work continued on gallium nitride, primarily to commercialize blue and violet LEDs and laser diodes.

Because of the weak market for gallium, the restart of a 50-metric-ton-per-year gallium facility in Australia that was originally scheduled for the fourth quarter of 2002 has been postponed. The U.S. firm that planned to operate the plant and expand its capacity to 100 metric tons per year has until December 2004 to begin actions to restart that plant without incurring a penalty according to the agreement with the plant's original owners.

Consumption of high-purity gallium in Japan was projected to decrease by 14% to 108 metric tons in 2002. Domestic production of 8 metric tons, imports of 55 metric tons, and scrap recycling of 45 metric tons were the components of Japanese consumption. Scrap consumption dropped sharply in 2002 to 45 metric tons from 67 metric tons in 2001.

World Production, Reserves, and Reserve Base: Data on world production of primary gallium are unavailable because data on the output of the few producers are considered to be proprietary. However, in 2002, world primary production was estimated to have dropped significantly to about 61 metric tons from about 75 metric tons in 2001. China, Germany, Japan, and Russia were the largest producers; countries with smaller output were Hungary, Kazakhstan, Slovakia, and Ukraine. Refined gallium production was estimated to be about 81 metric tons; this figure includes some scrap refining. France was the largest producer of refined gallium, using as feed material crude gallium produced in Germany. Japan and the United States were the other large gallium-refining countries. Gallium was recycled from new scrap in Germany, Japan, the United Kingdom, and the United States.

Gallium occurs in very small concentrations in many rocks and ores of other metals. Most gallium is produced as a byproduct of treating bauxite, and the remainder is produced from zinc-processing residues. Only part of the gallium present in bauxite and zinc ores is recoverable, and the factors controlling the recovery are proprietary. Therefore, an estimate of current reserves that is comparable to the definition of reserves of other minerals cannot be made. The world bauxite reserve base is so large that much of it will not be mined for many decades; hence, most of the gallium in the bauxite reserve base cannot be considered to be available in the short term.

World Resources:³ Assuming that the average content of gallium in bauxite is 50 parts per million (ppm), U.S. bauxite resources, which are mainly subeconomic deposits, contain approximately 15 million kilograms of gallium. About 2 million kilograms of this metal are present in the bauxite deposits in Arkansas. Some domestic zinc ores contain as much as 50 ppm gallium and, as such, could be a significant resource. World resources of gallium in bauxite are estimated to exceed 1 billion kilograms, and a considerable quantity could be present in world zinc reserves. The foregoing estimates apply to total gallium content; only a small percentage of this metal in bauxite and zinc ores is economically recoverable.

Substitutes: Liquid crystals made from organic compounds are used in visual displays as substitutes for LEDs. Researchers are also working to develop organic-based LEDs that may compete with GaAs in the future. Indium phosphide components can be substituted for GaAs-based infrared laser diodes in some specific-wavelength applications, and GaAs competes with helium-neon lasers in visible laser diode applications. Silicon is the principal competitor for GaAs in solar cell applications. GaAs-based integrated circuits are used in many defense-related applications because of their unique properties, and there are no effective substitutes for GaAs in these applications. GaAs heterojunction bipolar transistors are being challenged in some applications by a new material, silicon-germanium.

⁰Estimated. NA Not available. — Zero.

¹Producer published price series was discontinued. The price shown for 2002 is the estimated average value of U.S. imports for 99.9999%- and 99.99999%-pure gallium.

²Defined as imports - exports + adjustments for Government and industry stock changes.

³See Appendix C for definitions.