GALLIUM

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

Domestic Production and Use: No domestic primary gallium recovery was reported in 1998. 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 $9.2 million. Gallium arsenide (GaAs) components represented about 95% of domestic gallium consumption. About 44% of the gallium consumed was used in optoelectronic devices, which include light-emitting diodes (LED's), laser diodes, photodetectors, and solar cells. Integrated circuits represented 51% of gallium demand. The remaining 5% was used in research and development, specialty alloys, and other applications. Optoelectronic devices were used in areas such as consumer goods, medical equipment, industrial components, telecommunications, and aerospace applications. Integrated circuits were used in defense applications and high-performance computers.

Salient Statistics—United States:	1994	1995	1996	1997	1998[e]
Production, primary	—	—	—	—	—
Imports for consumption	16,900	18,100	30,000	19,100	23,000
Exports	NA	NA	NA	NA	NA
Consumption: Reported	15,500	16,900	21,900	23,600	23,000
Apparent	NA	NA	NA	NA	NA
Price, yearend, dollars per kilogram, 99.99999%-pure	395	425	425	425	595
Stocks, producer, yearend	NA	NA	NA	NA	NA
Employment, refinery, number[e]	20	20	20	20	20
Net import reliance[1] as a percent 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 (1994-97): France, 55%; Russia, 21%; Canada, 8%; Germany, 3%; and other, 13%.

Tariff: Item	Number	Normal Trade Relations (NTR) 12/31/98	Non-NTR[2] 12/31/98
Gallium metal	8112.91.1000	3.1% ad val.	25.0% ad val.
Gallium arsenide wafers, undoped	2851.00.0010	2.8% ad val.	25.0% ad val.
Gallium arsenide wafers, doped	3818.00.0010	Free	25.0% ad val.

Depletion Allowance: Not applicable.

Government Stockpile: None.

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GALLIUM

Events, Trends, and Issues: Notwithstanding the economic crisis in Asia, which has affected many U.S. "high-tech" industries, most U.S. publicly owned firms that are predominately dedicated to GaAs manufacturing reported increased revenues in the first half of 1998. Most of the increase in revenues resulted from increased shipments of GaAs devices to the wireless communications sector. GaAs manufacturers continued to introduce new devices for this market and expand capacity to meet the growing demand. A new GaAs heterojunction bipolar transistor facility opened in North Carolina in June, which uses proprietary technology to produce these devices on 4-inch wafers for commercial wireless applications. One Massachusetts-based firm announced plans to double its monolithic microwave integrated circuit production capabilities, again for use in the wireless communications market.

Japanese demand for gallium was estimated to be 107 tons in 1997, with 6 tons of domestic production, 53 tons of imports; recycled material provided the remaining demand. Kazakhstan (34%), France (22%), Russia (15%) and China (12%) were the principal import sources. The 1997 demand was a 16% increase from that of 1996 and was attributed to recovery in the LED and cellular telephone markets. Japanese gallium demand was expected to level off or decline slightly in 1998 as consumers reduced inventory levels that had increased at yearend 1997 and switched from liquid-phase-epitaxy processing methods to vapor-phase epitaxy, which uses less gallium.

Development of blue and purple laser diodes and LED's based on gallium nitride is rapidly progressing to commercial application. From a level of sales of $190 million in 1997, some projections anticipate sales growth to $950 million by 2000, an average annual growth rate of 38%. Potential large-scale uses for the blue and purple devices are in high-density data storage, laser printing, communications and lighting.

World Production, Reserves, and Reserve Base: Data on world production of primary gallium were unavailable because data on the output of the few producers were considered to be proprietary. However, in 1998, world primary production was estimated to be about 60,000 kilograms, with Australia, Kazakhstan, and Russia as the largest producers. Countries with smaller output were China, Hungary, Japan, and Slovakia. Refined gallium production was estimated to be about 55,000 kilograms. France was the largest producer of refined gallium, using as feed material crude gallium produced in Australia. Germany and Japan 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 was produced as a byproduct of treating bauxite, and the remainder was produced from zinc-processing residues. Significant reserves of gallium also occur in oxide minerals derived from surficial weathering of zinc-lead-copper ores. Only part of the gallium present in bauxite and zinc ores was recoverable, and the factors controlling the recovery were proprietary. Therefore, a meaningful estimate of current reserves could not 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 can be considered to have only long-term availability.

World Resources: 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 LED's. Indium phosphide components can be substituted for GaAs-based infrared laser diodes, and GaAs competes with helium-neon lasers in visible laser diode applications. Silicon is the principal competitor for GaAs in solar cell applications. Because of their enhanced properties, GaAs-based integrated circuits are used in place of silicon in many defense-related applications, and there are no effective substitutes for GaAs in these applications.

[e]Estimated. NA Not available.

[1]Defined as imports - exports + adjustments for Government and industry stock changes.

[2]See Appendix B.