

Weaponizing Critical Minerals, China Selects Gallium as Tool of Choice

written by | July 4, 2023

Announcement to Stop Exporting Gallium and Germanium on August 1st to have Massive Impact on Chip Market

At the recent [Critical Minerals Institute](#) (CMI) Summit II in Toronto, I was asked by the CMI co-founder Tracy Weslosky, along with my colleagues on a panel: which one of the critical minerals was our #1 choice for being most critical. Having been monitoring the [Top 5 Critical Mineral Markets](#) and maintaining a critical minerals list for the last several years for the CMI, I selected Gallium (Ga). Then explained that my rationale was that China dominates production with close to 98% of the world's exports of gallium. Adding that gallium is required for [semiconductors](#) "...a substance that has specific electrical properties that enable it to serve as a foundation for computers and other electronic devices", I offered the recommendation that we better find another source.

China agreed with me.

Yesterday there was an announcement out of China that will have massive ramifications for the semiconductor industry. China's Ministry of Commerce and General Administration of Customs decided to implement export controls on items related to gallium and germanium (Ge) to take effect on August 1, 2023. Furthermore, this same announcement as translated by Google states: "If exporters export without permission this constitutes a crime and will be held criminally responsible."

So, why is this significant? According to a [USGS Report](#), China produced 420 tonnes out of a global total of 430 tonnes of gallium in 2021, which is 98% of the world's supply.

What drove China to this decision? China typically does not make moves like this without some sort of thought-out process and usually in response to another action. In my experience, it is my opinion that this is in response to an American move in October 2022, which banned exports to China of high-end semiconductors and equipment to make these high-end semiconductors. In addition to this, the National Defense Authorization Act (NDAA) prohibited US government agencies from procuring products or services that contain semiconductors made by China's leading chip manufacturers. Needless to say, the immediate impact of this ban will be felt in Taiwan, South Korea, the USA and Europe. Again, according to the USGS, The USA imported 270 tonnes of gallium arsenide wafers in 2021. And SEMI, a global industry association that "unites the entire electronics manufacturing and design supply chain", estimates the equipment market in 2022 at over \$100 billion.

So, is there a replacement for gallium arsenide and gallium nitride? The short answer is yes and no. The properties of gallium arsenide (GaAs) allow transistors to operate at higher frequencies than silicon. It is used in mobile phones, satellite communications, microwave links, and high-frequency radar systems. In solar cell production, GaAs can absorb light better than Silicon (Si). Silicon is cheaper and has massive economies of scale, so it is the dominant chip material. It is easy to find while gallium is produced from zinc production and the production of bauxite. Obviously, there are potential sources outside China, but these would take time to develop. The Chinese announcement goes into effect in 4 weeks so there is little time to load up on inventories. I am not sure what inventory levels are, but I would be surprised if they exceed 6 months outside

China. This may force producers to move production to China, which is how they came to dominate the rare earth market as they eliminated the export of rare earth concentrates in the late 1990's and magnet manufacturers moved production to China to access raw materials. Given that designs have GaAs chips built into existing products any response would be lengthy and reduce performance.

When it comes to Germanium (Ge) there is less information available. About 75% of Ge comes from zinc production and the balance from coal fly ash. The [USGS](#) reported in 2020 that refinery production was 130,000 kgs with China having 86,000 kgs, Russia 5,000, and the rest of the world 40,000 kgs, which includes Canada, Belgium, Germany, Japan, and Ukraine. So obviously there are more options available for Ge as opposed to Ga but again the USGS estimates the USA consumption is around 30,000 kgs or 75% of the rest of the world's output.

As the impact of this announcement is understood it will be interesting to see the global response as China seems to be playing a very advanced level of critical minerals chess.