Laval University

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Two Hundred Years Cadmium

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Two Hundred Years Cadmium

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In 1817 the Inspector General of Apothecaries of Hanover Friedrich Stromeyer (1776-1835) (Figure 1) noticed during one of his inspection trips a certain preparation which, according to the Hanoverian Pharmacopoeia ought to contain zinc oxide, contained zinc carbonate instead. He visited the manufacturing plant at Salzgitter in Saxony and was informed that zinc carbonate could not be converted to oxide by heating without it turning yellow, although it was not possible to detect either iron or lead in the pure white carbonate.

Stromeyer took samples of this material to examine. He also acquired samples of a zinc preparation from Silesia that had been confiscated some years earlier on the supposition that it contained arsenic, because when it was dissolved in acid and then hydrogen sulfide was bubbled through, a yellow precipitate formed which was believed to be arsenic sulfide. Careful examination, however, revealed that the suspected zinc oxide did not contain arsenic.

Stromeyer then perceived that the yellow precipitate owed its existence to the presence of another metal, resembling arsenic but probably new. After extensive examination he confirmed that zinc oxide from different sources always contained this new metal. Because this new element occurred in the zinc ore calamine, a name derived from the Latin word “cadmia,” he named the new element cadmium.

Stromeyer was born in Göttingen and studied chemistry and pharmacy at its University, then went to Paris to work under the famous analytical chemist Louis Nicolas Vauquelin (1763-1829). In 1802, he returned to Göttingen as assistant professor and in 1810 became professor as well as Inspector General of the apothecaries. He was Robert Bunsen’s teacher. He authored in 1808 Grunddiss der theoretischen Chemie in two volumes.

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Occurrence and recovery

The average concentration of cadmium in the Earth’s crust is 1.5 x 10^{-5} % while zinc is 8 x 10^{-3}. Cadmium rarely forms its own minerals. It is always associated with zinc ores although their ionic radii differ notably. Greenockite, CdS, a rare cadmium mineral (Figure 2) was discovered in 1841 by Charles Murray Cathcart (Lord Greenock) (1783-1859), during excavating a tunnel near Port Glasgow. Lord Greenock an army officer incidentally became Governor General of Canada (1846-1847).

Cadmium melts at 320.9°C, boils at 767°C, and its density is 8.64 g/cm^3. Its crystal structure is distorted closest packed hexagonal. The metal burns at high temperature with a red-yellow flame to form brown cadmium oxide, which is poisonous. Cadmium dissolves readily in nitric acid but only slowly in hydrochloric or sulfuric acid and not at all in bases. At present cadmium is recovered from lead-zinc ores (Figure 3):

- The leach solutions of zinc calcines obtained by roasting zinc blende, by cementation with zinc dust.
- The dust collected in the bag filters during roasting galena.
- Zinc blende is roasted at a lower temperature the galena; that is why cadmium is not volatilized in this case and remains in the calcines. Cadmium is recovered from solution electrolytically.

Fig. 2: sample of greenockite, CdS, a rare cadmium mineral

Uses

After its discovery more than a century elapsed before cadmium or its compounds were employed to any significant extent. Only since the 1940’s production and consumption have risen. The primary uses are electroplated cadmium coatings, nickel-cadmium storage batteries, pigments, and stabilizers for plastics.

Cadmium pigments have particularly brilliant yellow and red colors (Figure 4), as well as a high durability. The use of cadmium is decreasing due to its toxicity. One of its new uses is in cadmium telluride solar panels (Figures 5 and 6).

Sandwichartiger Aufbau der SiGeSn-Diode

Zinn in der Photodiode
Nächster Schritt zur optischen On-Chip-Datenübertragung


D racial Schritt zur On-Chip-Datenübertragung

Fig. 6: Cadmium telluride in Sarnia, Ontario, Canada

References
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- M. E. Weeks, The Discovery of the Elements, Journal of Chemical Education, Easton, PA 1956

Fig. 4: Cadmium pigments – left: Cadmium yellow, CdS, right: Cadmium red, CdSe

Fig. 5: Cadmium telluride solar cell

Fig. 6: Cadmium telluride in Sarnia, Ontario, Canada