5. Summary of Data Reported and Evaluation

5.1 Exposure data

Gallium arsenide is extensively used in the microelectronics industry because of its photovoltaic properties. Gallium arsenide is produced as high purity single crystals and cut into wafers and other shapes which are used primarily for integrated circuits and opto-electronic devices. Exposure to gallium arsenide occurs predominantly in the micro-electronics industry where workers are involved in the production of gallium arsenide crystals, ingots and wafers, grinding and sawing operations, device fabrication and sand-blasting and clean-up activities.

5.2 Human carcinogenicity data

See Introduction to the Monographs on Gallium Arsenide and Indium Phosphide.

5.3 Animal carcinogenicity data

Gallium arsenide was tested for carcinogenicity in a single study by chronic inhalation exposure in mice and rats. In female rats exposed to the highest concentration, significantly increased incidences of alveolar/bronchiolar neoplasms, benign pheochromocytoma of the adrenal medulla and mononuclear-cell leukaemia were observed. There was no evidence of carcinogenic activity in male rats, or in male or female mice.

Gallium arsenide was tested by intratracheal instillation in male hamsters and showed no carcinogenic response. However, due to inadequacies in design and reporting, the study did not contribute to this evaluation.

5.4 Other relevant data

Gallium arsenide has low solubility. There is in-vitro and in-vivo evidence that gallium arsenide releases gallium and arsenic moieties.

Uptake from the gastrointestinal tract is low. In inhalation studies, lung retention of inhaled gallium arsenide has been shown to be influenced by toxic effects from gallium arsenide itself. Tissue burdens are highest in the lung. Concentrations of gallium and arsenic in blood and serum remain low in long-term inhalation studies. Concentrations of gallium in testes show evidence of accumulation, but at a much lower level than in the lung. After intratracheal instillation of gallium arsenide, data indicate slower elimination and higher serum concentrations of gallium compared with arsenic.

The most prominent toxic effect of gallium arsenide is pulmonary inflammation, which may occur after a single intratracheal dose. Gallium arsenide and gallium nitrate inhibit the activity of δ-aminolevulinic acid dehydratase.

Immunological effects of exposure to gallium arsenide include inhibition of T-cell proliferation and decrease of both humoral and cellular immune response. These effects are partly due to the arsenic moiety.

Testicular toxicity was observed in rats and hamsters exposed to gallium arsenide by intratracheal administration, while animals treated with arsenic trioxide and indium arsenide did not show these effects. In inhalation studies with gallium arsenide, decreased epididymal weights and reduced sperm mobility were observed. A number of reproductive toxic effects were reported following exposure of pregnant rodents to gallium arsenide. These effects were more severe in mice than in rats.

Based on limited data, gallium arsenide does not show genotoxic activity.

5.5 Evaluation

There is *inadequate evidence* in humans for the carcinogenicity of gallium arsenide.

There is *limited evidence* in experimental animals for the carcinogenicity of gallium arsenide.

Overall evaluation

Gallium arsenide is *carcinogenic to humans (Group 1)*.

The Working Group noted that there were no data on cancer in humans and that gallium arsenide is, at best, a weak carcinogen in experimental animals. In reaching an overall evaluation of *Group 1*, the Working Group noted the potential for gallium arsenide to cause cancer through two separate mechanisms of action. Once in the body, gallium arsenide releases a small amount of its arsenic, which behaves as inorganic arsenic at the sites where it is distributed. (Arsenic and arsenic compounds have been evaluated as IARC Group 1, carcinogenic to humans.) At the same time, the gallium moiety may be responsible for the lung cancers observed in the study in female rats, due to the apparent resistance of rats to the carcinogenic potential of arsenic that is manifest in humans. The similarity of toxicochemical responses observed in subchronic studies with gallium arsenide and gallium oxide adds weight to the finding that the gallium moiety is active and suggests that a carcinogenic response might be observed with other gallium compounds. The observed findings may also be a result of the combination of the two moieties.