

ERC Presentation

Indium



http://commons.wikimedia.org/wiki/File:Indium_wire.jpg



http://ec1.images-amazon.com/images/I/316yTImuuKL._AA280_.jpg



http://www.apple-g4.info/wpcontent/uploads/2009/06/cell-phone.jpg



http://www.vulcanelectric.com/images/Wafer.jpg

Uses and industry growth







mariasurmamanka.greenoptions.com



Hoffman 2006

Source: Strategies Unlimited 2007

Past Production and Future Growth



How will increased production affect environmental concentrations?

Evidence of Increasing Environmental Concentrations Sediment Cores



Evidence of Increasing Environmental Concentrations



- ~4x change in sediment concentrations (0.11 mg/kg versus 0.03 mg/kg)
- ~100x change in groundwater concentrations (9 ug/L versus
 0.01 ug/L) at Hsinchu Science-Based Industrial Park (Chen 2006)

Detrimental exposure levels?

- Toxicity to lungs has been found in humans at ~10⁶ times natural atmospheric concentrations (e.g. 50 ug/m³ versus 50 pg/m³)
- Other toxicity found in animals (weight loss, birth defects, tumors) at ~10⁷ 10⁹ times natural (e.g. 300 ug/m³ versus 50 pg/m³ by inhalation; mg/kg versus pg/kg by ingestion)
- BUT little known about effects of low environmental concentrations or chronic exposure
- Little known about organic species

Given our gaps in knowledge, what are the appropriate guidelines for use of indium?

- Don't want to simply prohibit
- Don't want to proceed blindly



- Gain knowledge of environmental transport and behavior
- Gain knowledge of cradle to grave industrial release



Some Definitions...



Coal Burning Releases





http://www.coal-is-dirty.com/a-coal-industry-front-groups-principled-attack-climate-action



The mining of Indium



Mining and Smelting Releases



Global, Regional: Dusts, fumes, emissions



://www.kitco.com/ind/Lee/oct202008.htm



10,000 tyr? Local: direct resources and leaching from tailings and residues 15

Mining and Smelting Releases



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560 t/yr Semiconductors, electronics Industry

//www.kitco.com/ind/Lee/oct202008.htm



10,000 tyr? Local: direct resources and leaching from tailings and residues 16



Semiconductor Releases

Boule and wafer production, Sputtering target production



Regional: Grinding, polishing may release indium to atmosphere

Possible evidence: illness and death in factory workers grinding ITO targets

Local: Grinding, polishing may result in solid and slurry wastes

Possible evidence: elevated groundwater levels near semiconductor industrial park, Taiwan

Semiconductor Releases

Physical Vapor Deposition



, Global, Regional: Likely small

Local: ~55% of metal lost to chamber walls in e-beam; ~30% lost during sputtering. What happens to metal when chamber is cleaned??

Possible evidence: elevated groundwater levels near semiconductor industrial park, Taiwan



Product Releases



http://magento-themes.joomlart.com/jm_purity/acerferrari-3200-notebook-computer-pc.html



Presently, semiconductor release is small compared to other releases.

What will happen as industry use grows?



Knowing how much indium used in semiconductors actually reaches the environment will be important in determining overall environmental release

Decreasing environmental concentrations due to Increased Demand?



Environmentally Benign Manufacture

- Occupational exposure: a serious consideration
- Environmental toxicity: an issue, despite lack of current regulation

– What are appropriate levels of containment?

Some of my present work: Indium in the atmosphere



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