Dear,

Please find below our contribution to the RoHS stakeholder consultation on InP

Best regards,

dr.ir. Luc Augustin

CTO

1. Applications in which indium phosphide is in use

a. Please provide information concerning products and applications in which the sub-stance is in use.

InP is used in optoelectronic devices and integrated circuits. InP is widely applied in optical communication devices, such as lasers and detectors. The material is a direct bandgap semiconductor that is able to emit light in the 1200-1700nm (and beyond) wavelength range, which is perfectly matched to the high transmission of optical fibers. InP based components are the drivers behind the internet for any optical communication further than a few hundred meters.

i. In your answer please specify if the applications specified are relevant to EEE products and applications or not.

InP plays a crucial role in the whole data driven society. All telecommunication transceivers consist of an InP based laser.

ii. Please elaborate if substitution of the substance is already underway in some of these applications, in relation to the properties for which indium phosphide is used (for example semiconductor and photovoltaic properties) and/or in relation to specific applications in which it is used (for example critical communication components),

It is impossible to replace InP as this is the only direct bandgap semiconductor that has the unique property to grow lattice-matched quarternary materials (InGaAsP, InAlGaAs) to have high reliability lasers. The bandgap of the InP-InGaAs system can be engineered to performance for optical communications in the 1310nm and 1550nm spectral ranges.

iii. Where relevant, please elaborate which chemical (on the substance level) or which technology (elimination of the need to use InP) alternatives may be relevant for this purpose.

None available

b. Please specify if you are aware, if aside from actual use of the substance, it may be re-introduced in to the material cycle through the use of secondary materials.

Not aware

c. Please specify in which applications indium phosphide is used as a material constituent, as an additive or as an intermediate and what concentration of indium phosphide remains in the final product in each of these cases (on the homogenous material level).

Typical lasers used for optical communications or photonic integrated circuits for a multitude of other applications consist mainly (>>90%) of InP. These devices are typically less than 0.1mm^3 for

discrete devices and less than 5mm^3 for integrated circuits. In a transceiver the mass or volume content of these InP is far below 1%

2. Quantities and ranges in which indium phosphide is in use

a. Please detail in what applications your company/sector applies indium phosphide and give detail as to the annual amounts of use. If an exact volume cannot be specified, please provide a range of use (for example – 10-100 tonnes per annum).

The applications for our InP chips range from optical communications, to sensing for structural health monitoring in constructions, aerospace, sensing for high tech systems, and various applications under development. Total consumption of InP is 10-100 kg/annum.

b. Please provide information as to the ranges of quantities in which you estimate that the substance is applied in general and in the EEE sector in the EU and globally.

InP is used in lasers and integrated circuits in the majority of the telecom transceivers. Globally in total 150M pieces /year in 2017 [Lightcounting, Integrated Optical Devices, January 2016]

c. If substitution has begun or is expected to begin shortly, please estimate how the trend of use is expected to change over the coming years.

Not applicable

3. Potential emissions in the waste stream

a. Please provide information on how EEE applications containing indium phosphide are managed in the waste phase (with which waste is such EEE collected and what treatment routes are applied)?

No comment

b. Please detail potentials for emissions in the relevant treatment processes.

No comment

4. Substitution

a. Please provide details as to the substitution of indium phosphide:

i. For which applications is substitution scientifically or technically not practicable or reliable and why.

InP is the only direct bandgap semiconductor with a bandgap that can be tuned to emit between 1200 and 1700nm. This is needed for optical communications > 1km to 10.000km. there is no substitute for reliable lasers in this wavelength range.

ii. For which applications is substitution underway? Please specify in this respect which alternatives are available on the substance level (substitution) and which are available on the technological level (elimination). For example, which alter-natives can be applied instead of indium phosphide used in solar cells and in semiconductor applications (e.g. gallium arsenide)

Due to its physical properties and bandgap, there is no substitute. GaAs can be used only in different spectral region.

iii. What constraints exist to the implementation of the named substitutes in a specific application area (provide details on costs, reliability, availability, roadmap for substitution, etc.).

Not applicable

5. Socio economic impact of a possible restriction

Please provide information as to the socio-economic impacts if indium phosphide is to be restricted under RoHS. Please specify your answers in relation to specific applications in which the substances are used and/or in relation to the phase-in of specific alternatives in related application areas. Please refer in your answer to possible costs and benefits of various sectors, users, the environment, etc. where possible; please support statements with quantified estimations.

The total market for InP transceivers alone is estimated to be close to 10 billion euros per annum, of which a significant part is produced in Europe. As there is no substitute for the InP laser, banning InP would stop the whole optical backbone of the internet.

Next to the optical communications, InP is used in structural health monitoring using Fiber Bragg Gratings, theser require light sources in the telecom spectral windows (1300-1550nm). Furthermore in a number of emerging technologies such as integrated circuits for applications in automotive, aerospace, medical diagnostics, etc.

6. Further information and comments

The information compiled on this substance for the stakeholder consultation has been prepared as a summary of the publicly available information reviewed so far. If relevant, please provide further information in this regard, that you believe to have additional relevance for this review, as well as references where relevant to support your statements.

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