OLYMPUS OSSA

Submission for beryllium and its compounds

Abstract

Beryllium metal properties needed for optimal peformance in XRF

1. General questions

a. In past processes for identifying substances of relevance for possible restriction under RoHS, only beryllium metal and beryllium oxide were considered. The current as-sessment looks at a broader scope in this respect, namely beryllium and its com-pounds. Please specify, should a restriction be considered, if it should be limited to beryllium metal and beryllium oxide or expanded to include beryllium and its compounds.

Olympus OSSA:

Olympus OSSA does not purchase or use directly any beryllium compounds. We only have interest in Be metal as it related to the use in x-ray devices such as tubes and detectors. Olympus-OSSA would not be affected by a restriction on Be compound.

b. Please provide information to support your view, including information as to the use and presence of additional beryllium compounds in EEE placed on the EUmarket (e.g. beryllium–copper alloy, beryllium sulfate, beryllium chloride etc).

Olympus OSSA:

To our knowledge Olympus-OSSA does not use EEE components containing Be compounds or Be alloys. We are only concerned with thin Be foils used as x-ray windows on tubes, detectors and isotope sources.

2. Applications in which beryllium metal and beryllium oxide are in use

a. Please provide information concerning products and applications in which the substances are in use.

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

Olympus OSSA:

Olympus-OSSA purchases from third parties x-ray detectors which use windows from 8um to 25um Be. These windows are made of Be metal foils. These windows serve 3 purposes in detectors. Allow the transmission of x-rays down to low energies (<1 keV), maintain a vacuum inside the detector by providing an impermeable barrier to gases and moisture, and finally to exclude light and other longer wavelength electromagnetic radiation which could reach the detector.

We also purchase x-ray tubes which have Be windows from 75-250um thick. The windows are made of Be metal foils. In x-rays tubes the windows serve three purposes. They allow the transmission of x-rays down to low energies that are produced by the x-ray tube; provide a vacuum seal, and for transmission target x-ray tubes, they support the target material (thin Rh, Ag, W, or Au) and help to dissipate heat from the target. Typically x-ray tubes are assembled and sealed using a vacuum brazing technique which means that the window sees temperatures in excess of 400C during manufacture.

Both x-ray tubes and x-ray detectors are electrical devices, which are integrated into our x-ray spectrometer products, so it follows that they are EEE products or applications.

ii. Please elaborate if substitution of the substance is already underway in some of these applications in relation to the properties for which beryllium metal and beryllium oxide are used and/or in relation to specific applications in which it is used (for example beryllium copper alloys used in flexible contacts for batteries), and where relevant elaborate, which chemical (substance level) or technology (elimination of the need for beryllium) alternatives may be relevant for this purpose.

Olympus OSSA:

For x-ray detectors which do not have a high heat load and have to span a small open area, there are some alternative materials that can be used for x-ray windows. For example, Silicon Nitride, supported polymers, and more recently Graphene have been used as window materials. All of these windows have downsides compared to Be metal.

Silicon Nitride windows are transparent to visible light and so have to be coated with Al metal to make them light tight. This means that the Window now consists of 3 different elements, N, Al & Si. In an XRF device, customers are interested in measuring the amounts of Al and Si in materials and so this window cannot be used for accurate quantification of those elements.

Polymer windows are transparent to visible light, and offer excellent transmission at low x-ray energies, but to achieve this the window has to be extremely thin, which makes it vacuum tightness and light tightness poor. The window is typically supported on a Si framework which also prevents the measurement of Si in samples. These windows can only be used in specialist applications where light can be excluded, and a vacuum exists on both sides of the window.

Graphene windows are made of Carbon sheets. Since Carbon is element 6 in the periodic table it is a stronger absorber of x-rays than Be (element 4) so it has to be made thinner to achieve the same x-ray transmission. The fabrication of Graphene windows is not routine and the window requires a Si support skeleton and has to be glued rather than welded to a support cap.

For x-ray tubes which need to output low energy x-rays < 3keV from the L-lines of the target material, there are no alternative materials that can offer the combination of requirements of x-ray transmission, vacuum tightness, heat dissipation, and high temperature processing.

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

Olympus OSSA:

We are not aware of any secondary materials that could introduce Be or its compounds

i. Please detail in this case what secondary materials may contain impurities of beryllium or of its compounds (please specify which) and at what concentrations as well as in the production of what components/products such materials are used.

ii. If possible please provide detail as to the changing trends of concentrations of beryllium and its compounds in such secondary materials as well as the changing trend of use of the respective secondary material in EEE manufacture.

3. Quantities and ranges in which beryllium and its compounds are in use

a. Please detail in what applications your company/sector applies beryllium and its compounds and give detail as to the annual amounts of use (please specify which data is relevant for which compound). If an exact volume cannot be specified, please provide a range of use (for example – 50-100 tonnes per annum).

Olympus OSSA:

We estimate our total annual amount of Be metal used in x-ray windows for all our products is <100 g per year. The amount of Be in a typical detector window is < 10mg.

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.

Olympus OSSA:

We do not have a good estimate of the amount of Be used in other x-ray applications, such as medical, x-ray inspection etc.

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.

Olympus OSSA:

The use of Be in x-ray products is unlikely to change in the future, because Be metal offers a unique set of properties that cannot be found in any other material. Be is the lightest stable metallic element with good mechanical and thermal properties, and can be coated or treated to make it corrosion resistant and chemically stable.

4. Potential emissions in the waste stream

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

Olympus OSSA:

All x-ray equipment is serviced and repaired by in house technicians. Any broken or failed parts are retained for appropriate recycling, and are not introduced into the general waste stream. We offer trade in programs and return of old units by our customers so that we can provide safe segregation and disposal of parts containing Be.

b. In the treatment and the destruction processes of electronic components beryllium ox-ide can be released and result in health risks for workers. Please detail potentials for emissions in the relevant treatment and disposal processes specified relevant to each application EEE. Please also detail how such impacts can be mitigated and to what degree such practices are applied in recycling facilities in the EU and outside the EU.

Olympus OSSA:

Tubes and detectors used by Olympus are not enter the normal recycling stream.

c. Please specify if there is a risk for emissions of additional beryllium compounds.

Olympus OSSA:

We do not believe there is a risk of Be emissions from our equipment. The material is in a solid metallic form, and is not subject to mechanical or chemical wear or abrasion.

5. Substitution

a. Please provide details as to the substitution of beryllium and its compounds (as a minimum for beryllium metal, beryllium oxide and beryllium copper alloys):

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

Olympus OSSA:

For x-ray windows in tubes we do not believe there is another material which can replace Be metal. Be metal offers a unique set of properties that cannot be found in any other material. Be is the lightest stable metallic element with good mechanical and thermal properties, and can be coated or treated to make it corrosion resistant and chemically stable. Any alternative metal or material would be denser (and therefore more opaque to x-rays).

ii. For which application 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) and in which of the beryllium applications they can be applied (for example which substitutes cab be applied for copper beryllium alloys used in flexible contacts for batteries) .

Olympus OSSA:

For detector windows some substitution is underway. Silicon Nitride, Polymers and Graphene have all been used. Each has some disadvantages compared to Be which is superior in all aspects, or strength, transmission and light-tightness.

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.)

Olympus OSSA:

There is no other material which possesses the same physical properties as Be which makes it the ideal window material for the transmission of low energy (<3keV) x-rays.

6. Socio economic impact of a possible restriction

Please provide information as to the socio-economic impacts of a scenario in which beryllium metal and beryllium oxide or beryllium and its compounds are 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.

Olympus OSSA:

Olympus-OSSA uses x-ray tubes and detectors, containing Be windows, to make devices that are used in a range of applications. Be makes it possible to sort and recycle Aluminum alloys based on the Mg, Al and Si concentrations. It allows the determination of rock chemistry for mining and oil and gas exploration. They are used for the testing of ROHS/WEEE compliance, where detection of light elements is an important factor in determining the total amount of hazardous elements (Pb, Hg, As, Cd, Br, Cr) in materials. Without Be windows many of these applications would be impossible or extremely difficult using XRF. At worst, they would not work at all, and at best, the results would be considerably more error prone and inaccurate than results today. One possible impact is that recycling of materials would become more expensive, slower or more error prone because alternative technologies are less accurate or take longer.

7. Further information and comments

The information compiled on these substances 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.

Olympus OSSA:

Here are a list of references to information about x-ray windows, and links to why it is the ideal material:

- https://materion.com/products/beryllium-products
- https://materion.com/products/beryllium-products/x-ray-foil
- https://materion.com/-/media/files/electrofusion/case-studies/mef-imagingequipment_vareximagingcorp_6-17.pdf?la=en&hash=D6CFD55184B5EE38DFC3E4DA3F2679AAC5641F57
- http://moxtek.com/xray-product/duraberyllium-windows/
- https://www.oxford-instruments.com/OxfordInstruments/media/x-ray-technology/application-notes/Caring-for-the-Beryllium-Window-of-an-X-ray-Tube.pdf
- http://pd.chem.ucl.ac.uk/pdnn/diff2/abs.htm