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Freiberger's comments to the ECHA consultation on the 6th priority list of substances for inclusion in Annex XIV

- Attachment to the comment for diboron trioxide -

CAS Number: 1303-86-2
EC Number: 215-125-8

Statement on possible alternatives

Explanation for the application of diboron trioxide used in processes to manufacture gallium arsenide

Diboron oxide is used in ultra-pure quality as a massive cylinder (see fig. 1) for the synthesis and single crystal growth of various semiconductor compound materials of groups III and V of the Periodic Table of Elements.

Figure 1: Diboron trioxide cylinder as supplied in a vacuum-sealed packaging

In particular, it is applied for processes with materials containing a component which might escape from the melt at high temperatures such as arsenides and phosphides e.g. gallium arsenide and indium phosphide. These are all materials which are necessary for high-frequency electronic applications for mobile communication as well as in opto-electronic devices, for Concentrator Photo-Voltaic (CPV).

Diboron trioxide forms a glass-like melt with low density, an extreme low level of metallic impurities of a few ppb and controllable water content in the range of 200 – 2000 ppm. By targeted adjustment of the water content in boron oxide and the regulation of partial pressure of carbon oxide gas above the molten boron oxide, the ratio between oxygen and carbon as well as the impurity level of the melt can be controlled. Thus, the semi - insulating properties can be set up in the entire crystal (see figure 2).

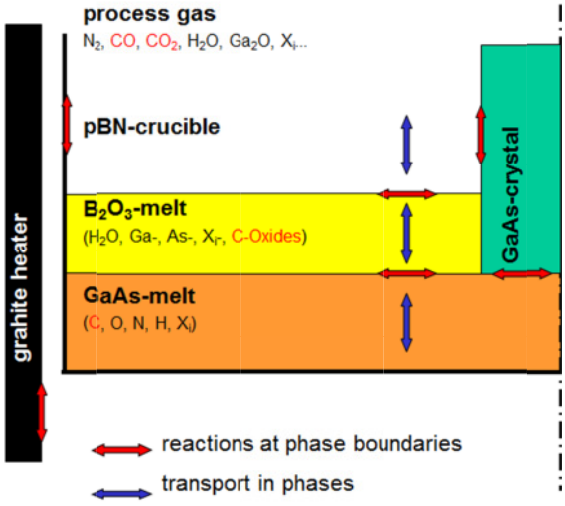

Figure 2: chemistry of the system diboron trioxide/process gas/GaAs melt/GaAs crystal

Boron atoms are replacing gallium and indium atoms in the crystal lattices of GaAs or InP generating an iso-electronic defect without influencing the electrical properties of the semiconductor.

This combination of all properties of the diboron trioxide used as a cover for the ultra-pure melts in synthesis (see figure 3) and in the GaAs crystal growth processes either applying the Liquid-Encapsulated-Czochralski technique (LEC, see figure 4) or the Vertical-Gradient-Freeze technique (VGF, see figure 5) cannot be replaced by another substance. Diboron trioxide is essential for these processes.

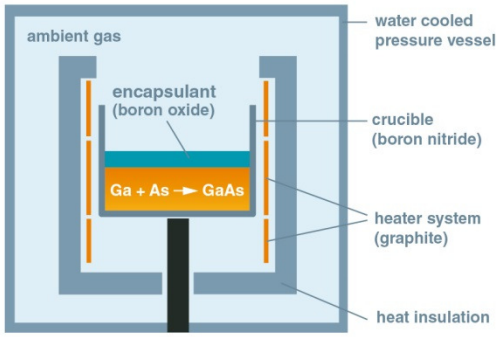

Figure 3: principle of GaAs synthesis

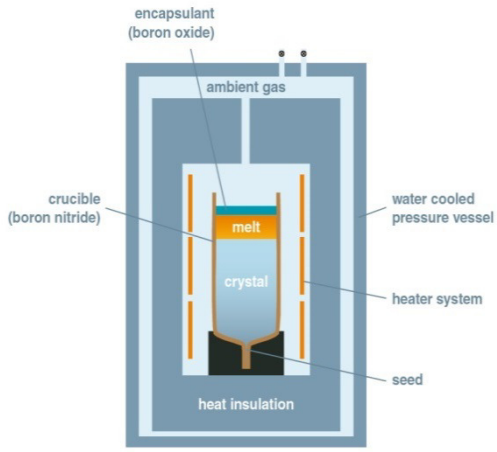

Figure 4: principle of VGF crystal growth

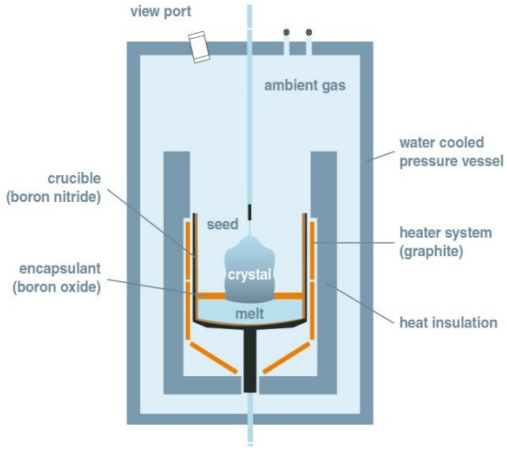

Figure 5: principle of LEC crystal growth

Although several technologies for the production of semiconductor materials have been developed and improved globally in the past 50 years there is no alternative substance/mixture for this purpose.

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