

Protocol for working with III-V materials

Some III-V materials are known to be carcinogenic, although not all risks are known to the KN staff members, your general practitioner or even the Dutch poison centre (NVIC Universitair Medisch Centrum Utrecht). To minimize the potential risks of III-V materials, this protocol was made. Please read the MSDS of your III-V material before usage, if available.

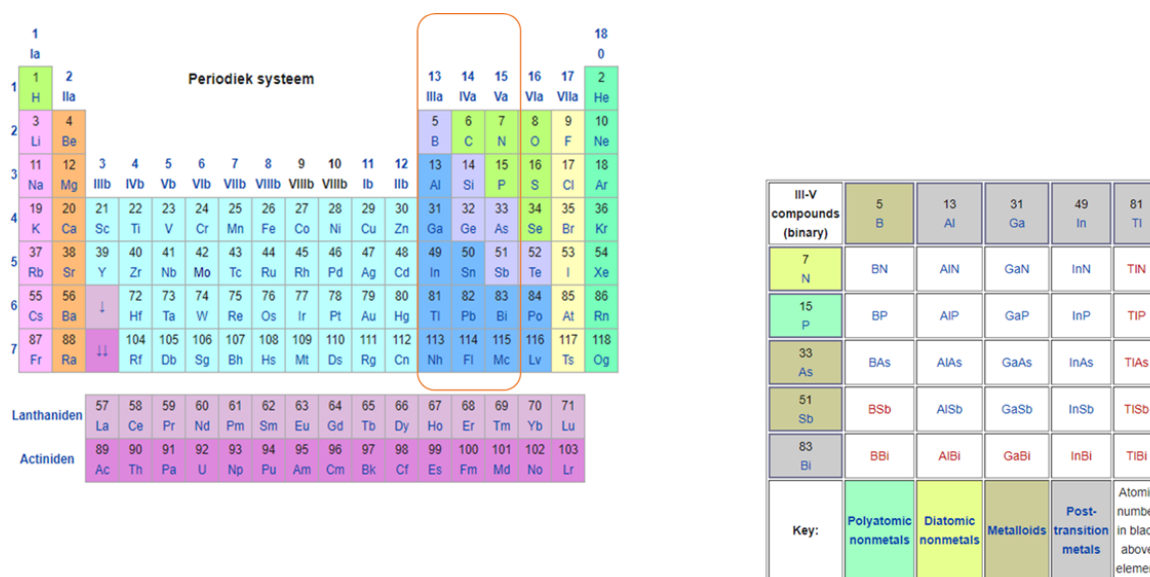
What are III-V materials

A III-V material is a chemical compound combined with at least one group III-element and at least one group V-element. The most common materials used in the cleanroom are shown in Table 1.

Table 1 Example of III-V materials inside of the cleanroom.

III- element	V- element
B	N
Al	P
Ga	As
In	Sb

This type of materials can be used inside the cleanroom for semiconductors. All the III-V material possibilities are shown in Figure 1.



Chemical compounds with at least one group III (IUPAC group 13) element and at least one group V element (IUPAC group 15).
III refers to the boron group (the table columns). V refers to the nitrogen group (the table rows).

Figure 1 Figures showing all III-V materials (Category: III-V compounds, 2021).

Points of concern when working with III-V materials

The points of concern regarding III-V contamination in the Kavli Nanolab cleanroom is particle generation by chipping/breaking of III-V wafers and contact with physisorbed III-V's (e.g., As on the back of III-V grown substrates).

We distinguish 3 category areas where dust particles can be generated:

1. Allocated location: Locations where particles might be generated during the process, like dicing and breaking of substrates, but also mounting and/or removing samples from holders/stubs at the EBPGs and SEMs. In these areas local exhaust is present to prevent particles moving into the cleanroom air stream.
2. Undesired location: Location without exhaust, which is not meant for breaking III-V materials and with risk of breaking substrates or chipping of sharp edges. As III-V wafers are very brittle, substrate handling is very delicate. For this reason, a dedicated protocol for working with III-V materials is made (see below).
3. Potential location: Areas where surface is in contact with backside of III-V material grown substrates.

Protocol for working with III-V materials

This protocol needs to be digitally signed for agreement by all the Kavli Nanolab cleanroom users. This will be registered in the NIS program.

- When entering the cleanroom gowning area, PE gloves are used to avoid possible contamination of III-V materials from your suit and boots to be transferred onto your nitrile gloves or outside the cleanroom.
- Use dedicated tweezers with plastic or carbon tips and keep them in their own package. Do not hang them on your cleanroom suit, but treat them as contaminated.
- Try to avoid using III-V in gel-pack boxes due to the possibility and risk of breaking your III-V substrate. If you need to use a gel-pack box, only remove your substrate under extraction.
- Removing your substrates from a dicer foil or from a III-V holder is done only under extraction.
- Breaking or scribing is only allowed in the cleaving benches (module TU09 and TU14). Dicing is done in the Disco dicer tool.
- Disposal of waste material is done in the dedicated 'III-V & silicon' waste bins.
- Use double pair of nitrile gloves when handling III-V materials and dispose the upper pair after use. Never touch other things outside of the allocated area with your contaminated gloves. Dispose gloves and tissues in the 'Residual' waste bins.
- Seal your sample boxes in a seal bag for transport out of the cleanroom.
- Use substrate carriers, aluminium foil or wipes under your samples where possible. Throw the aluminium foil or wipe away in a 'Residual' waste bin after use. For SEM use dedicated stubs or holders.
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Clean up III-V particles

When working with III-V materials at allocated locations, you will always work clean and safe.

- In case of unexpected breakage at the allocated location, you must remove the particles using a vacuum cleaner with HEPA filter, dedicated for III-V materials, or wipe up the particles by IPA wiping. NB: For EBPG substrate holders IPA wiping is not allowed and the procedure with the vacuum cleaner applies.
 - *Vacuum cleaners can be found next to the breaking and scribing tools and at the EBPGs.*
- In case of accidental breakage of III-V (or an unknown material) at an undesired location, secure the location using the safety warning A-boards and warn the KN staff to clean up the area. *In off-*

hours when no staff is available, secure the location using the safety warning A-boards and warn the KN staff by mail to clean it up the next workday.

- Safety warning A-boards can be found in the main corridor of the KN cleanroom in the III-V cabinet.

Flowchart for III-V material incidents

A short summary on what to do during a III-V material incident is shown in Figure 2.

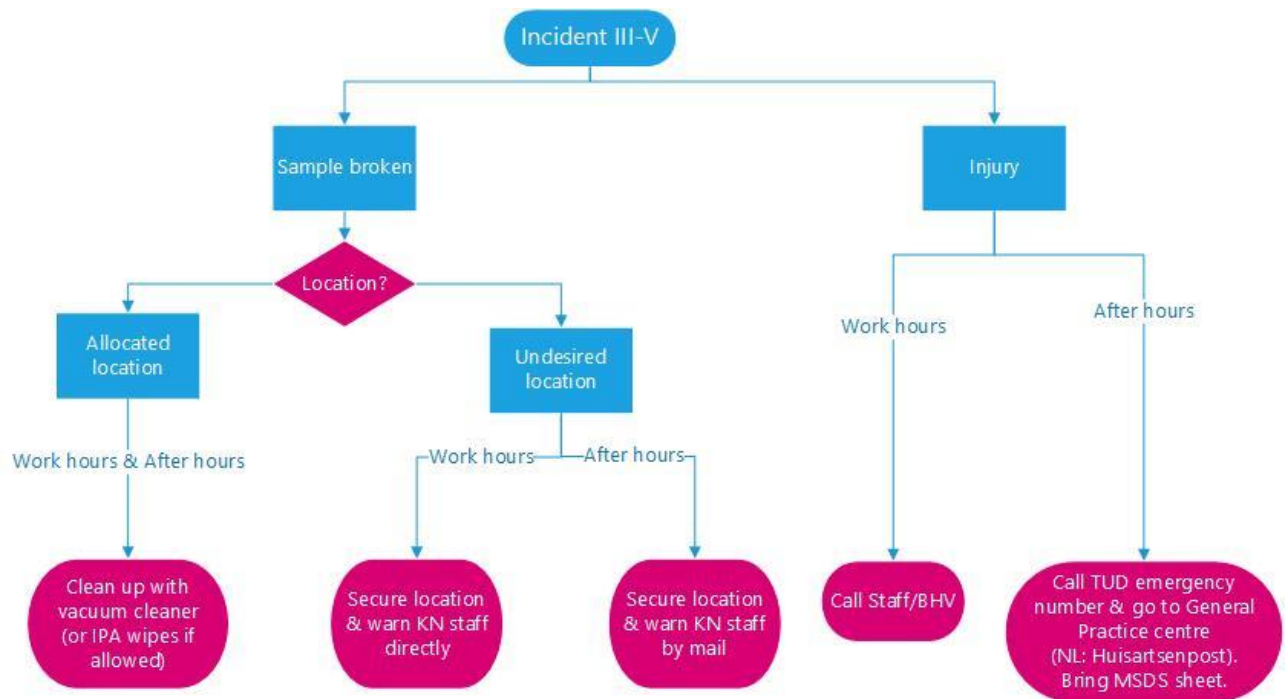


Figure 2 Flowchart for incidents with III-V materials.

Storage of III-V materials

You can get a special III-V box at room D173 (office E. Straver & P. Stevic) which will be labelled with your name and “III-V Materials”.

By digitally signing this form:

- I show that I understand why I need to sign this form and that I understand that working with III-V materials can give a potential risk.
- I show that I understand how to work safely with III-V materials and know what to do in case of a breakage.