Y. Jiao, Institute for Photonic Integration, Eindhoven University of Technology

PIC handling instructions

1.General info

This document briefly discusses the dos and don'ts of handling photonic integrated circuits (PICs). The PICs that are fabricated by InP foundries are based on the indium phosphide (InP) material system, which makes them very fragile. Any mechanical damage on the edges may lead to self-propagating cracks and self-cleaving of the chip. Note that the PICs are typically finished with a grinding thin-down process. The final substrate thickness can be only about 200 µm.

2.Typical look of a PIC

Figure 1 shows a typical PIC under the microscope.

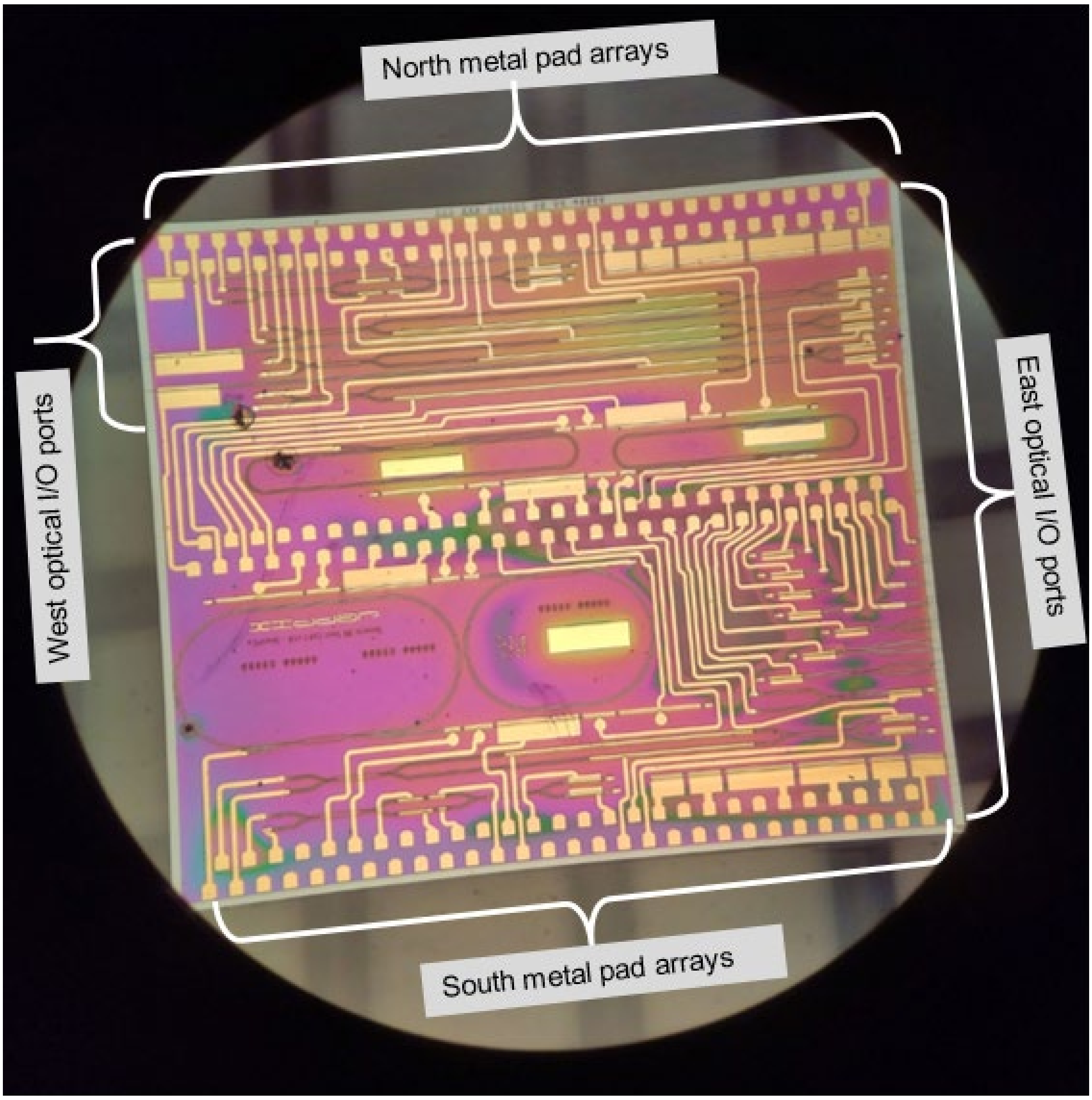

Figure 1. Typical PIC under a microscope.

Waveguides (gray lines and curves) and metal interconnects (golden stripes) are visible on the chip surface. The waveguide is formed by etching ~2 μm deep trenched at both sides. The metal stripes are mainly pure gold with thickness ranging from 300 nm to 2 μm, depending on the driving method (voltage or current). Both waveguides and metals are fragile. Therefore, touching the surface with a hard object (even plastic tweezers) is forbidden.

Typical JePPIX InP foundry chips have all metal contacts and bond pads arranged at the north and south edges, while all optical I/O ports (waveguide facets) are arranged at the east and west edges. The waveguide ports can be perpendicular or tilted with an angle with respect to the edge, both are common. Sometimes a coating with rainbow color can be seen on top of the waveguides close to the edge facet. This is due to either high reflection coating (HRC) or anti-reflection coating (ARC).

3. Handling of PICs

InP foundry chips are usually delivered in Gel-Pak boxes. Figure 2 gives an example. The chips are tightly stuck to a layer of gel, so that they are safe from the mechanical vibrations and impacts during transportation.

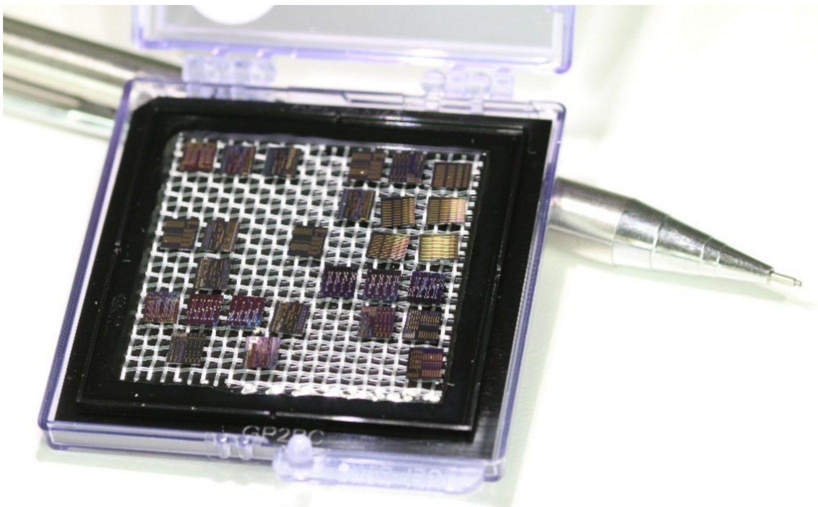

Figure 2. PIC chips in a gel-pak box.

To release the chips from a Gel-Pak box, a vacuum releaser is required. The vacuum releaser will reform the gel surface, so that the chips are no longer firmly held by the gel. Another vacuum pen is needed to pick up the chip and move it to the desired location. Only use a proper Gel-Pak vacuum releaser and vacuum pen for handling of PICs. This YouTube video may help.

NEVER use any kind of tweezers to try to clamp at the edges and pick the chip up, while the chip sticks firmly to the gel. It will not work, but only break the fragile chip! Also, any mechanical touch at the optical I/O edges will easily damage the waveguides and their optical properties. Good optical property relies on perfectly cleaved facets formed by natural crystal planes.

After transferring the chips from Gel-Pak box to the desired location, e.g. a vacuum chuck for temporary chip measurement or a permanent assembly stage (see example pictures in Figure 3), it might be needed to micro-adjust the position of the chips.

Always try to first use the vacuum pen for this. If using a vacuum pen is too difficult, the second option is a soft plastic tweezer. When adjusting the position with a tweezer, **REMEMBER** always **ONLY** gently touch the north/south edges where metal pads are located. **NEVER** touch the east/west edges with optical facets!

The use of the chip may take days or even longer. Make sure the chip is always fixed on the chuck or stage, by either vacuum or permanent paste. The chips are so light weight that any vibrations or mistaken touching may cause the loose chip fall and break. If a vacuum is used, leave the vacuum pump running 24/7.

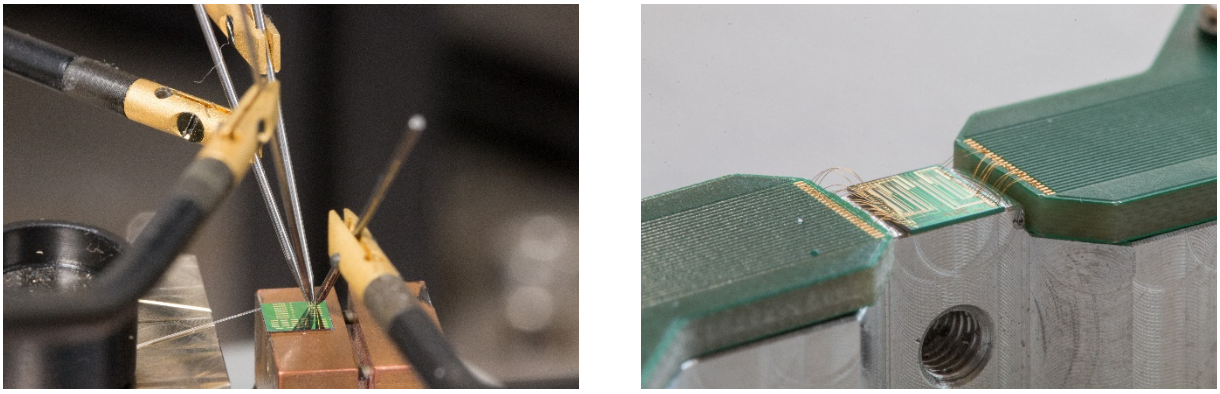

Figure 3. Left: chip under measurement on a vacuum chuck; Right: permanent chip mounting and wire-bonded to PCB.

4. In need of post-processing

If you need to post-process the chips, e.g. extra coating, extra lithography/etch, remember what the consequences of each added step will be. The consequences highly depend on the process chemistry and/or environment (like heater and oven) and will be at the user's own risks. Common risks include accidently lift-off of the metals on the surface, accelerated oxidation of cleaved facet leading to degraded optical quality, as well as contaminations from process-induced residuals and particles.