POSTER #25-17

SWTEST
PROBE TODAY, FOR TOMORROW

Probing test system with optical fiber array for photonic integrated circuits

Developing, Delighting
yokowo

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➢ Introduction

- In recent years, the need to process vast amounts of digital data has been increasing, as exemplified by the rapid expansion of AI technologies.
- To meet the demands for higher speed and lower power consumption, there is a growing trend in semiconductor devices to handle optical signals in addition to electrical signals.

- The rapid introduction of Photonic Integrated Circuits (PICs) utilizing silicon photonics technology has led to an increasing need for both electrical and optical probing during wafer-level testing.
- However, in the development of probers capable of electrical and optical testing, there are still challenges in building testing systems suitable for mass production.

Opto-electrical probe card for PIC Wafer

Electrical test + Optical test

- This paper reports on the challenges and solutions in the development of probe cards aimed at enabling both electrical and optical testing.

➢ Purpose

- A method is available that enables wafer-level testing of Known-Good-Die (KGD) by directly accessing the Grating Couplers (GCs) on the PIC wafer surface using optical Single Mode Fibers (SMFs).
- We will make probe cards that can be seamlessly integrated into existing conventional probers and support the implementation of user-specified optical fiber arrays.

➢ Concept

- To achieve effective high optical coupling between the GC and the SMF, higher alignment precision is required compared to conventional electrical probers, which typically provide alignment within a few micrometers.
- Therefore, we will implement a separate alignment mechanism to enable alignment to the optical fiber with submicron accuracy.
- Figure 1 shows an overview of the alignment scheme.

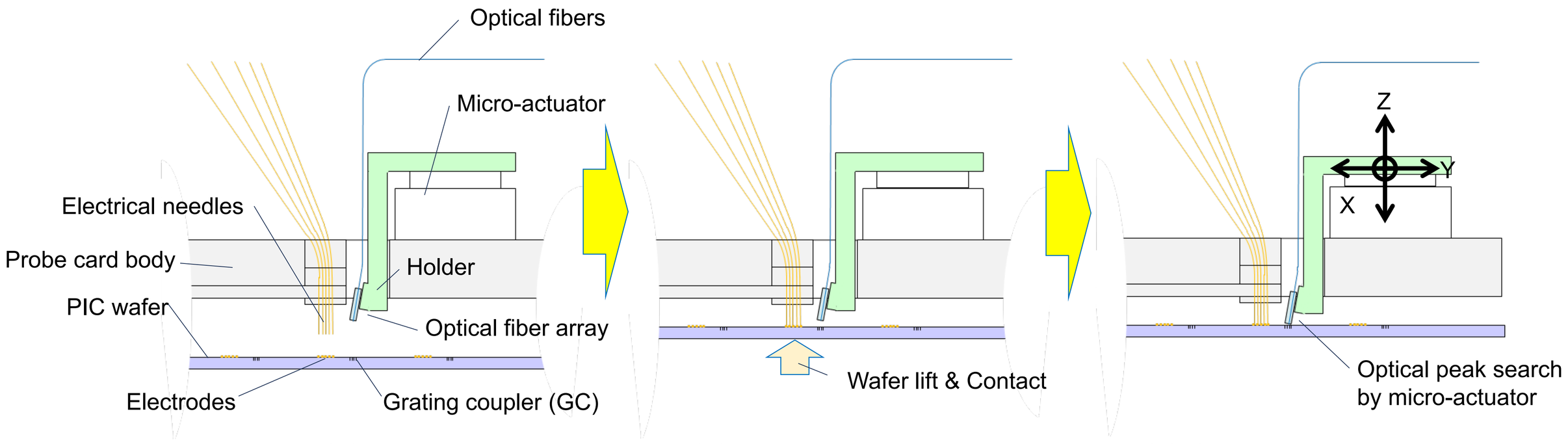


Fig. 1 Overview of the alignment scheme

➢ Approach

(1) Requirement for high-precision optical alignment

- Figure 2 shows a measurement example of the alignment tolerance of the optical coupling between GC and SMF. The 1-dB loss tolerance is ±2.5 μm, which is much narrower than the tolerance of a conventional electrical prober.
- Therefore, we implemented a configuration on our probe card in which the SMF array is mounted on a micro-actuator, enabling sub-micrometer precision alignment in the XYZ directions relative to the GC.
- Figure 3 shows a side view of optical alignment setup using our probe card. The left side of the photograph shows optical alignment using SMF, and the right side shows alignment using a 32-channel SMF array.

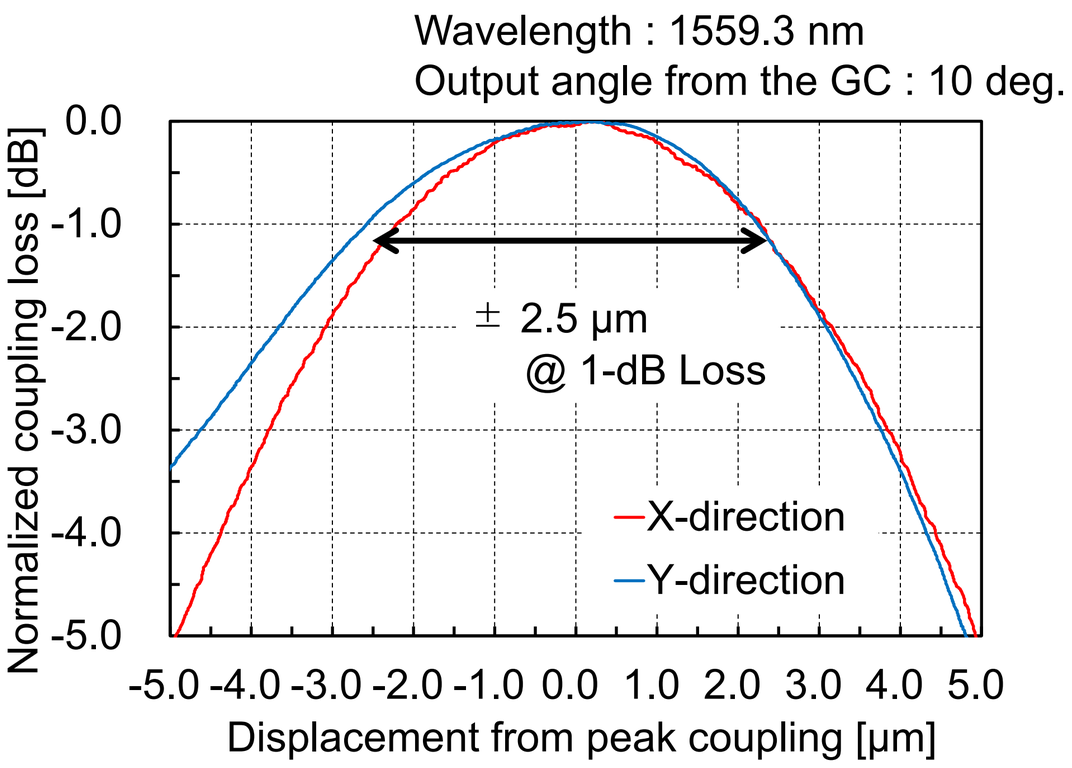


Fig. 2 Measured alignment tolerance

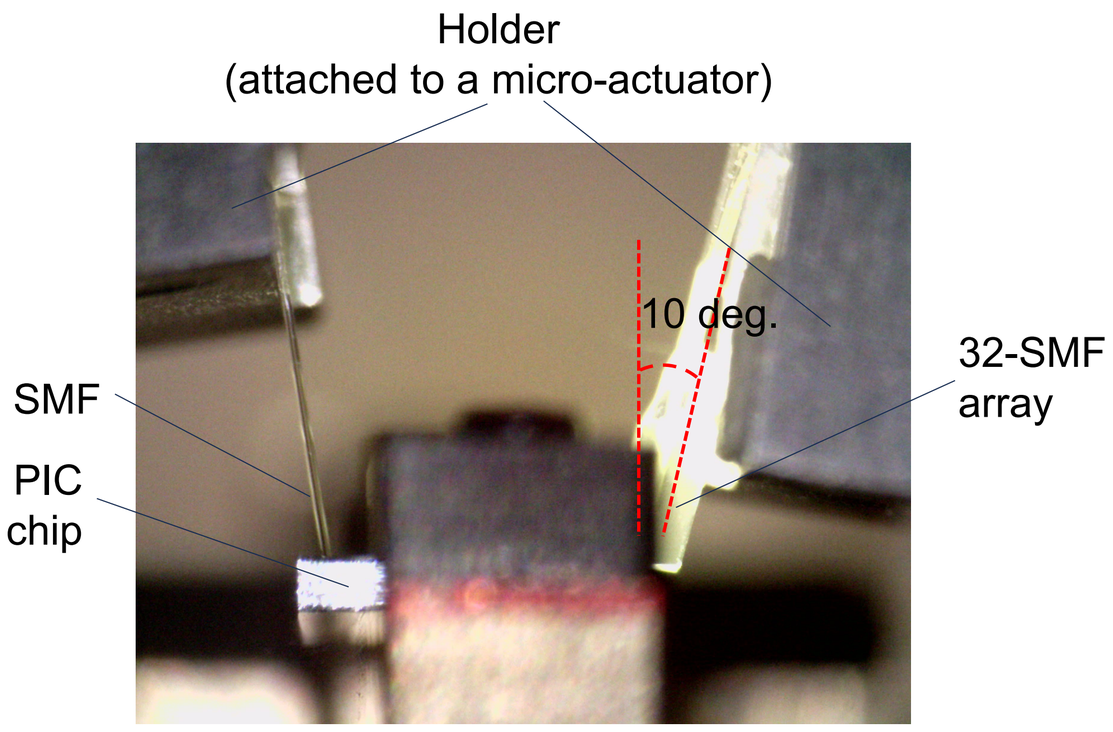


Fig. 3 Side view of the alignment setup

(2) Scalability in the number of optical input/output ports

- Increasing the number of optical I/O ports per PIC chip and testing multiple PIC chips simultaneously significantly impacts the productivity of various product types. Therefore, we will provide user-specified interchangeable optical fiber arrays.

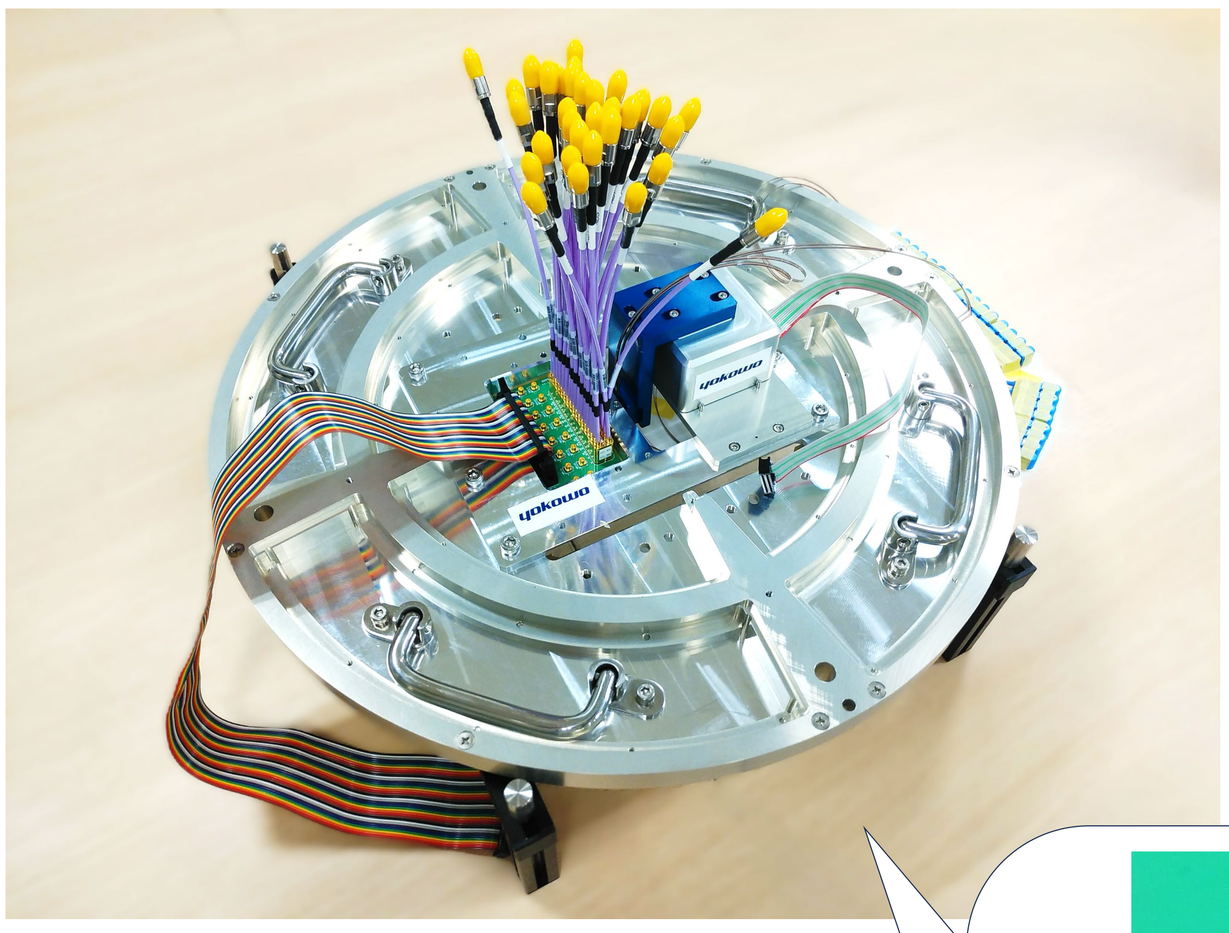
(3) Optimization of optical coupling conditions

- It is preferable that the light input/output angle to the GC is adjustable.
- Polarization-maintaining single-mode fibers (PMFs) are prepared to match the polarization axis orientation.
- It is also possible to use high-numerical-aperture (NA) fibers if required.

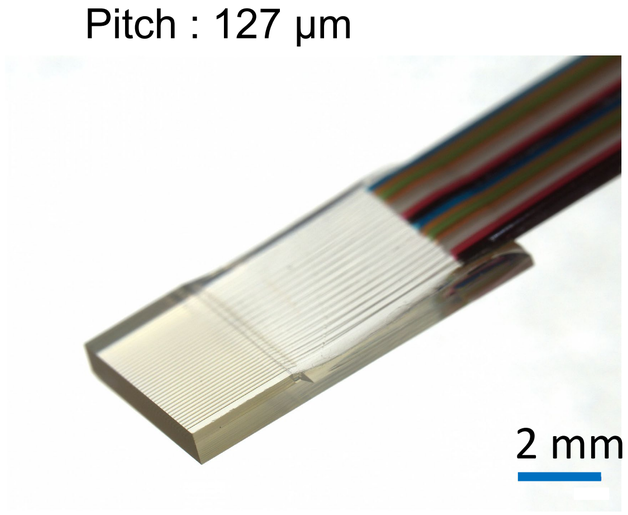
(4) Electrical test with optical probing

- Electrical probes with less than 100 μm pitch are used to measure DC signals such as continuity checks, impedance evaluation, and PD dark current testing.
- High-frequency signal testing is also supported if required.

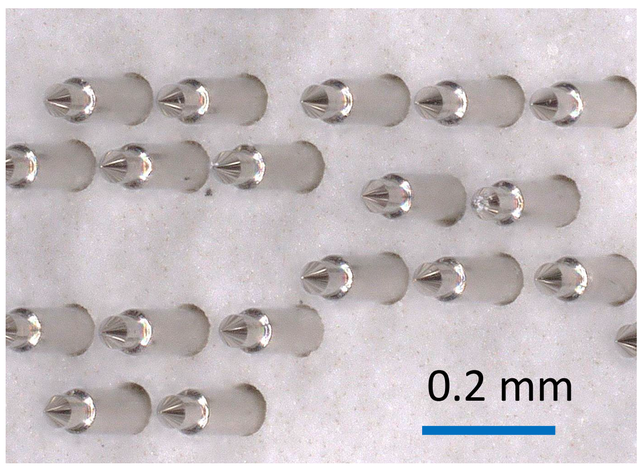
➢ Probe card *

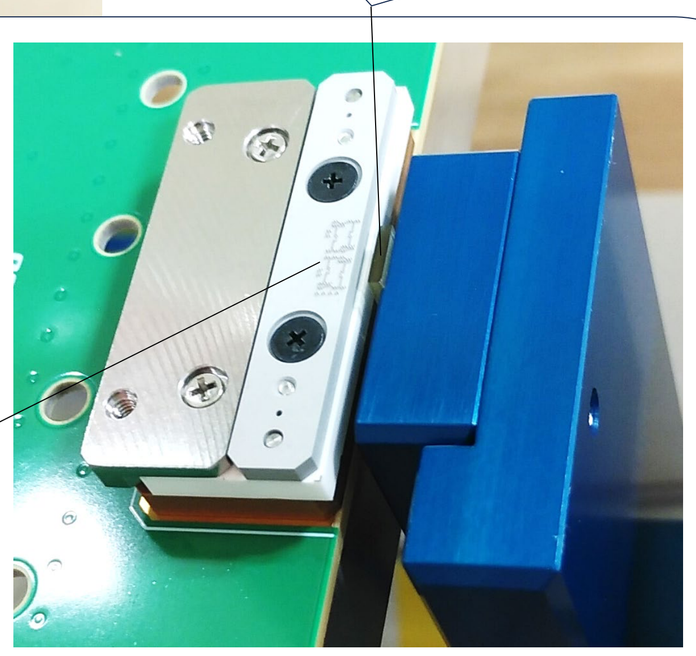


Optical fiber array
Number of channels : 32
(including PMFs)
Pitch : 127 μm



Electrical probes
Length : 2 mm、Pitch:130 μm





Enlarged view of the probe side

* On display in the exhibition booth No.206.

➢ Summary

We propose a probe card that can be set up on conventional probers and is equipped with a high-precision alignment mechanism for user-specified optical fiber arrays.

➢ Contact Information

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