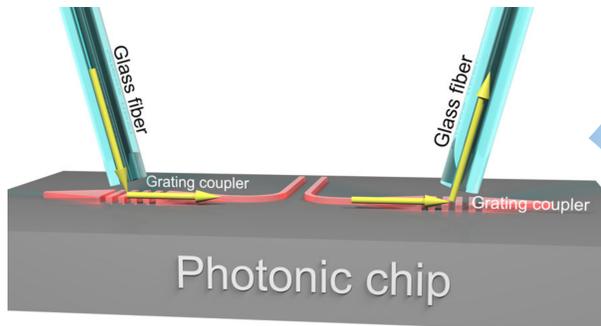


# Planar fiber-chip-coupling using angle-polished polarization maintaining fibers

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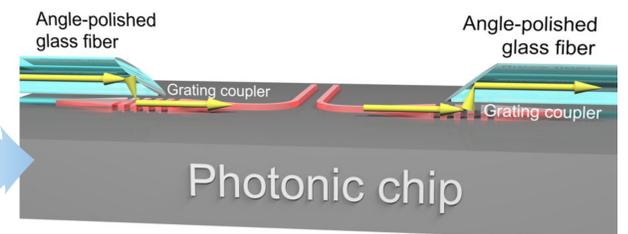
Karlsruhe Institute of Technology (KIT), Institute for Data Processing and Electronics (IPE), Germany



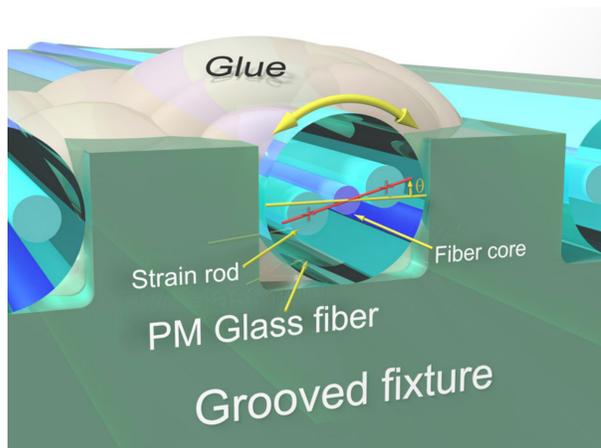
Conventional fiber-chip-coupling for on-chip grating couplers

## Fiber-chip-coupling with grating couplers on silicon photonic chip:

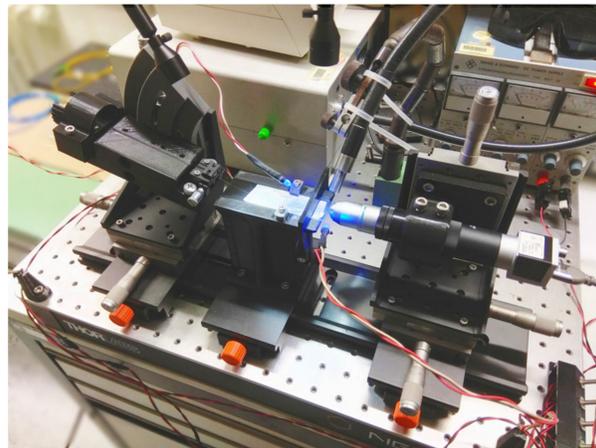
- Light in- and output nearly vertical to chip surface
- Coupling with cleaved fibers bulky
- Angle-polished glass fibers provide flat, space-saving, and stable coupling
- Polarization maintaining fibers must be polished in correct orientation to achieve high coupling efficiency



Planar fiber-chip-coupling with angle-polished fibers



Polarization maintaining (PM) fibers must be aligned before polishing



Alignment setup with fiber rotator and microscope camera, fixation done by UV-glue

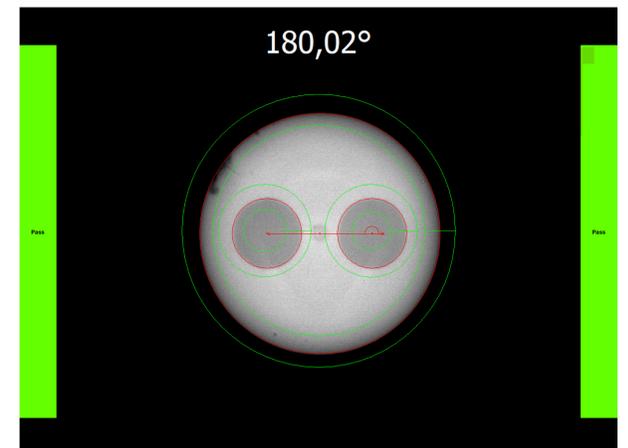
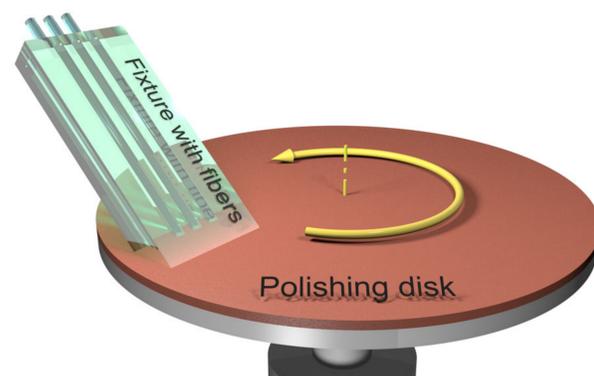


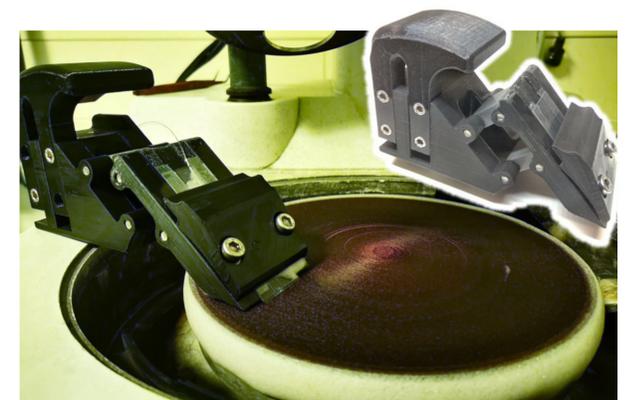
Image of fiber tip in alignment program with angle measurement through strain rod recognition

## Fiber polishing process:

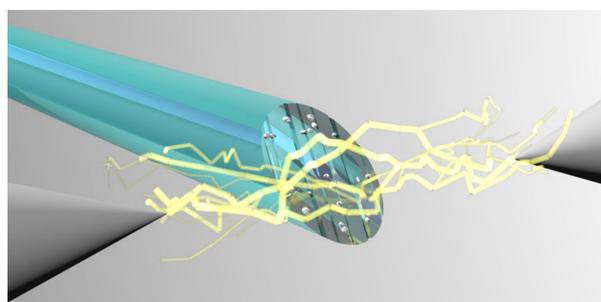
- Alignment of fiber in grooved fixture
- Fixation by UV-glue (DELO Photobond GB368)
- Mounting in angled fiber chuck to provide correct polishing angle
- 1 min. lapping film 15  $\mu\text{m}$ , 200 rpm
- 5 min. lapping film 8  $\mu\text{m}$ , 200 rpm
- 8 min. diamond emulsion 3  $\mu\text{m}$ , 150 rpm
- 8 min. diamond emulsion 1  $\mu\text{m}$ , 150 rpm
- 8 min. diamond emulsion 0.25  $\mu\text{m}$ , 150 rpm
- Removal of fiber from fixture using acetone
- Electric cleaning arc in fiber splicer
- ⇒ Clean and smooth mirror surface



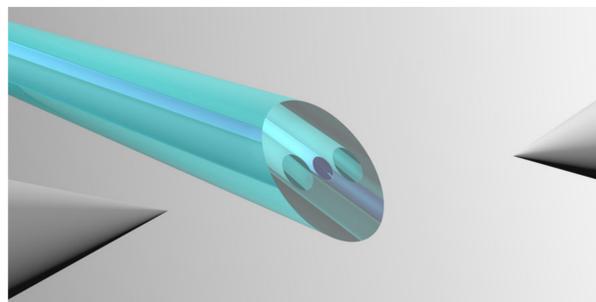
Fiber polishing with rotating polishing disk



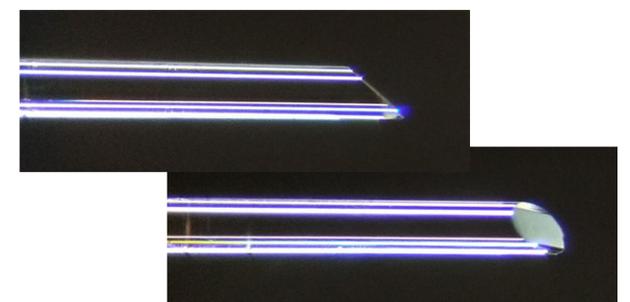
Polishing setup with 3D-printed, angled fiber chuck



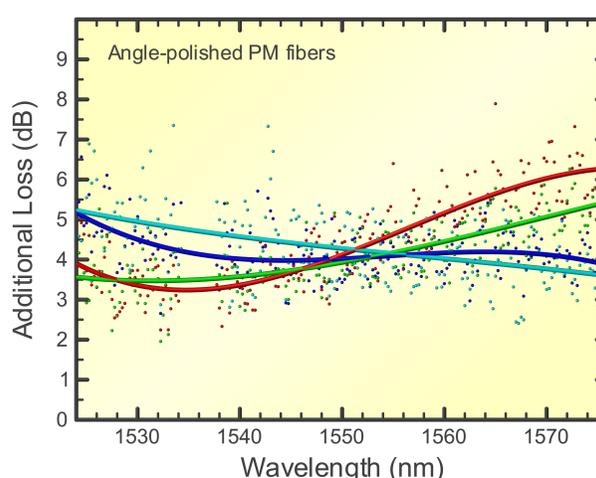
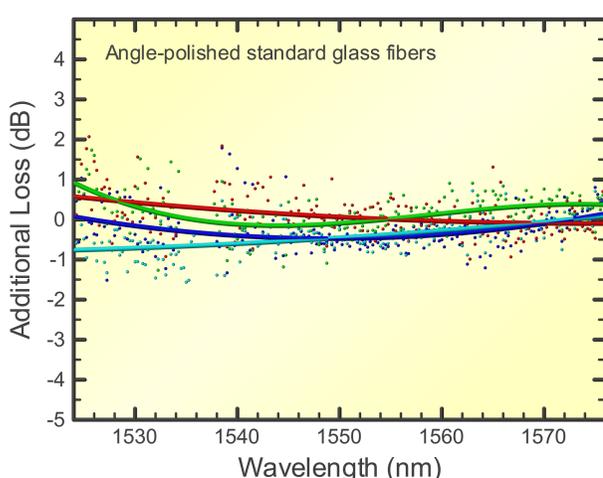
Electric arc smoothes remaining scratches and removes residues



Result: clean and smooth mirror surface on fiber tip



Microscope images of angle-polished fiber



## Result:

- Planar fiber-chip-coupling using angle-polished standard glass fibers imposes no additional loss compared to vertical coupling
- Angle-polished PM fibers induce approx. 5 dB higher loss per coupling
- Tighter process control and tolerancing might reduce this loss