

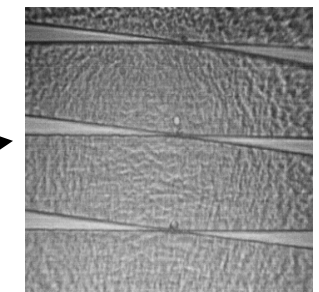
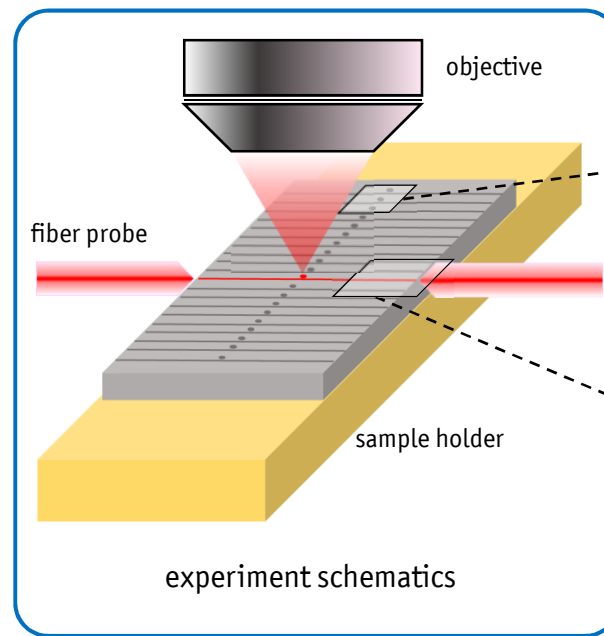
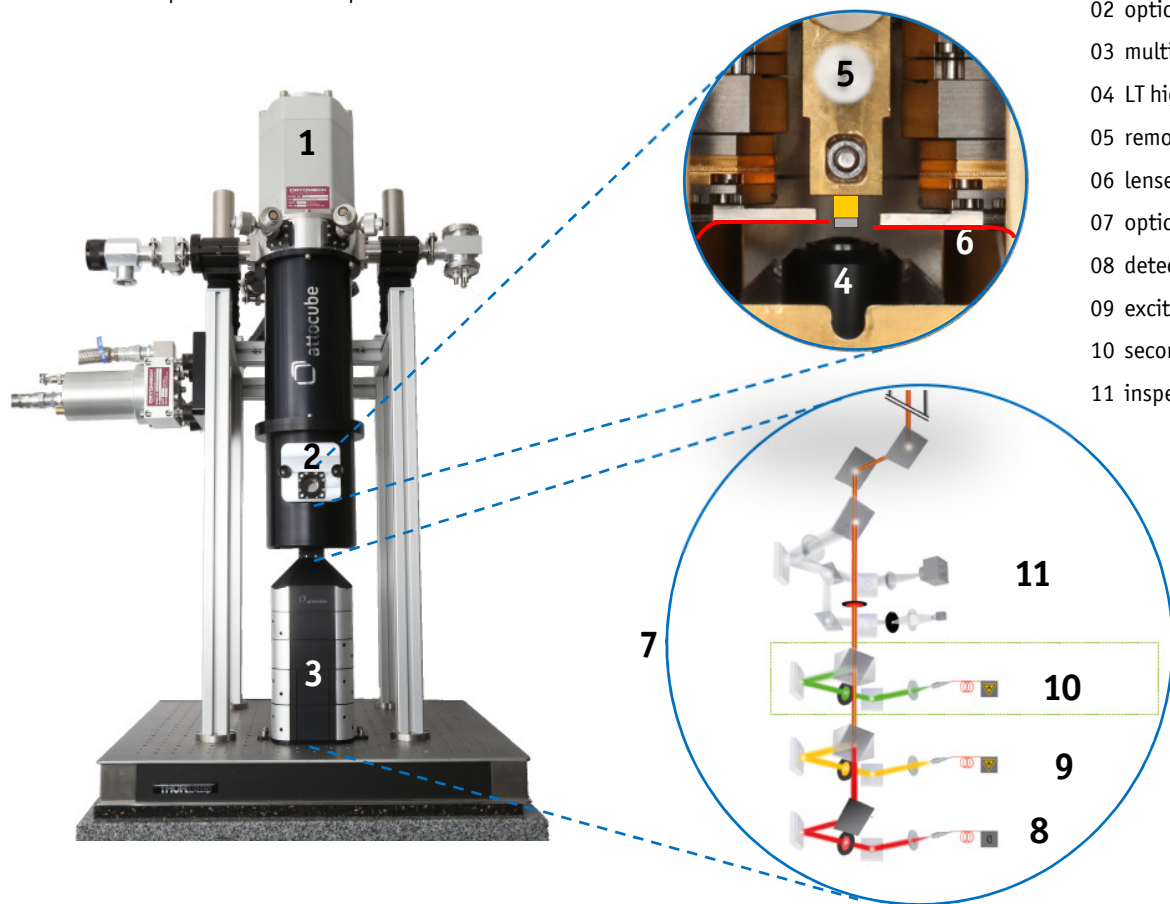
Cryogenic Photonic Probe Station

combined probe station and confocal microscopy

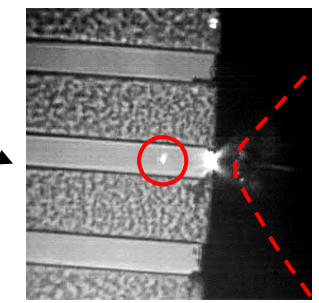
Photonic Integrated Circuits (PIC) are hot candidates for becoming the key components of the next generation of optical and quantum communication systems, because of the promise of very high information transfer speed, robustness and the compatibility with standard microelectronics devices technology. Furthermore the extremely high sensitivity of resonant nanophotonic structures to light-matter interactions makes them candidates for a new classes of sensors with broad range of possible applications in physics, biology and chemistry. The Photonic Probe Station, which combines two optical fiber probes and a free optical beam Confocal

Microscope (CFMI) provides an ideal, ultra-stable, extremely compact and easy-to-use table top setup for nano-photonic device characterization. The lensed fibers couple in and out the light into the sample planar wave guides. The confocal microscope allows not only for sample surface probing, but also for out-of-plane coupling into photonic structures. The combination with the attoDRY700 table top cryostat offers a powerful easy-to-use setup for characterization of photonic nanostructures in a temperature range from 3K up to 300K.

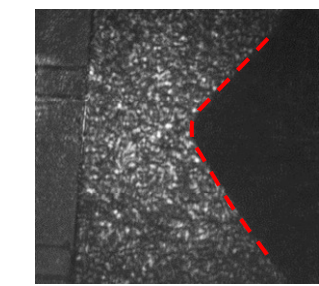
- 01 attoDRY700 cryostat
- 02 optical access to sample
- 03 multi-beam optical head
- 04 LT high NA objective
- 05 removable sample holder
- 06 lensed fiber holder
- 07 optical head schematics
- 08 detection channel
- 09 excitation channel
- 10 second excitation channel
- 11 inspection optics



Nano-resonators and planar wave guides



Coupling from the lensed fiber into the planar wave guide. Marked the confocal spot and the lensed fiber end



Lensed fiber at the edge of a planar wave guide sample

Key features

- Large area sample positioning (15x10mm²)
- 2 optical probes (lensed fibers)
- Ultra low drift at low temperature

Benefits

- Quick sample exchange
- Inspection optics 90x70μm² FOV
- 1" side optical access to the sample chamber

Applications

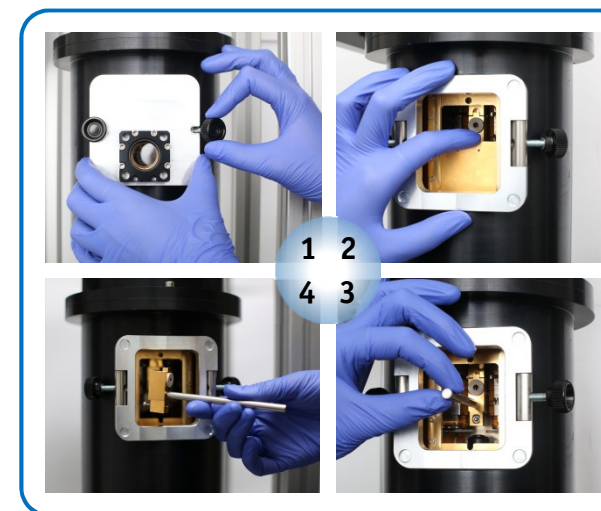
- Characterization of nanophotonic structures
- Spectroscopy of single QD in nanoresonator
- Biosensors
- Nano-plasmonics
- Opto-electronics devices

Sample courtesy of Ivan Favero, Université Paris Diderot-CNRS (attocube application labs 2014)

Specifications

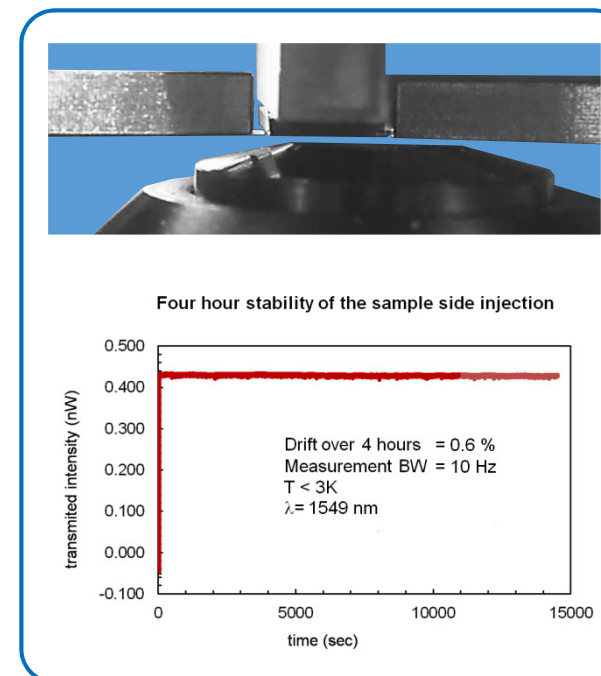
cryogenic Photonic Probe Station

Cryogenic Photonic Probe Station setup	
Setup	Combined side injection into planar waveguide structures and perpendicular confocal optics on top of the sample. Perpendicular injection is possible.
Fiber probes	Two independent lensed fiber probes with 3 individual degrees of freedom
CFM	attoCFM I external optics head and low temperature compatible, high-NA objective
Cryostat	Table-top closed-cycle system, pulse-tube cooler based
CFM specifications	
External optics head (see attoCFM I)	compact and modular design, up to three optical channels, standard configuration: 1 excitation channel, 1 detection channel
Long-term stability	lateral drift of confocal spot typically < 2 nm/h
Low temperature compatible objective	NA = 0.82, WD = 0.4 mm, confocal resolution ~ 550 nm (@635 nm in reflection), spectral range 300..1600 nm (>80% transmission)
key benefits	quick and reliable alignment of each channel, steering mirror for the combined beams exceptional long-term stability
quick-exchange of optical components	beamsplitters, filter mounts for up to 4 filters / polarizers (1" diameter), optional piezoelectric rotator with filter mount
inspection unit	sample imaging with large field of view: ~ 100 μ m
Open loop Z range = focus range	6 mm
Sample Positioning & Mount	
Closed loop coarse positioning range (x,y)	15 mm x 10 mm
Encoder	sensor resolution ~ 200 nm, sensor repeatability ~ 1-2 μ m
sample mount	carefully thermalized, quick exchange mechanism, including calibrated temperature sensor and heater
Fiber probes	
Type	lensed-fiber probes, different models/types on request
Coarse positioning range (x,y,z)	5 mm x 5 mm x 5 mm (limited by sample in x direction and by the objective in z direction)
Encoder	sensor resolution ~ 200 nm, sensor repeatability ~ 1-2 μ m
Cryostat	
temperature range	< 3 K..300 K
cooldown/warm up time	6h / 3h
sample exchange time	~ 1-2 min.



Quick and easy sample exchange

The vacuum chamber and the sample holder have been designed to allow for a very quick and user friendly sample exchange procedure. The flange in front of the cryostat is opened without tools (1) and the sliding port in the cold shield is manually moved down (2). With the provided tool the sample holder (3) is securely extracted from the cryostat (4).



Ultra-low drift

The integration of the Photonic Probe Station into the attoDRY700 cryostat allows for characterization of photonic structures in a temperature range from 3K up to 300K.

The stability of the light injection and detection is outstanding: ultra low drift of the transmitted signal intensity in the range of only a few percent in a period of several days is detected. A typical 4h measurement is presented. The experiment schematics is shown below.

