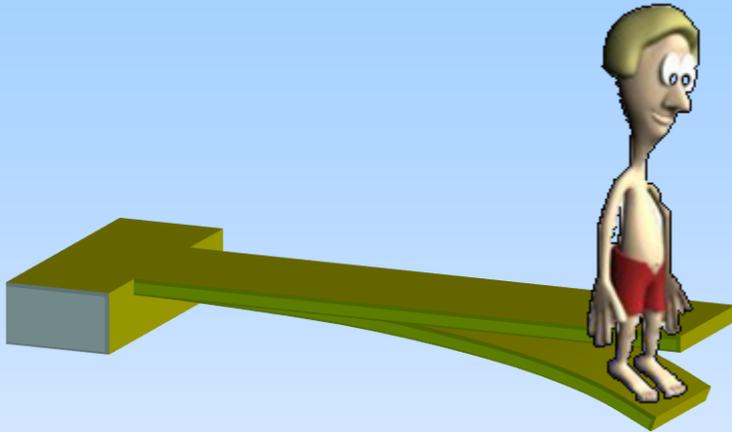


# Fiber-top micromachined devices

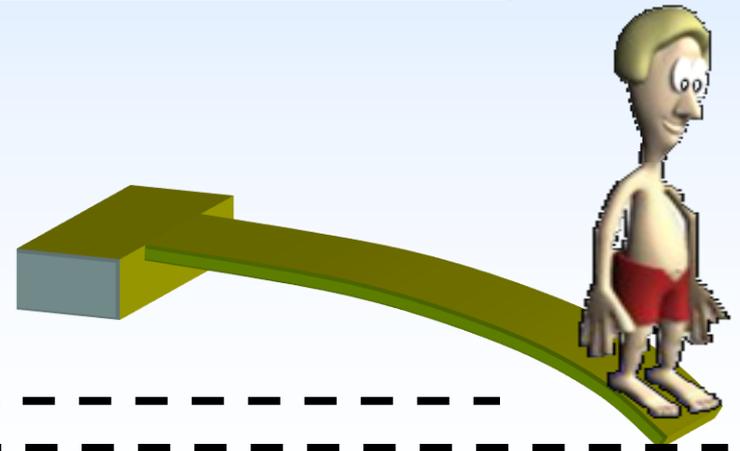
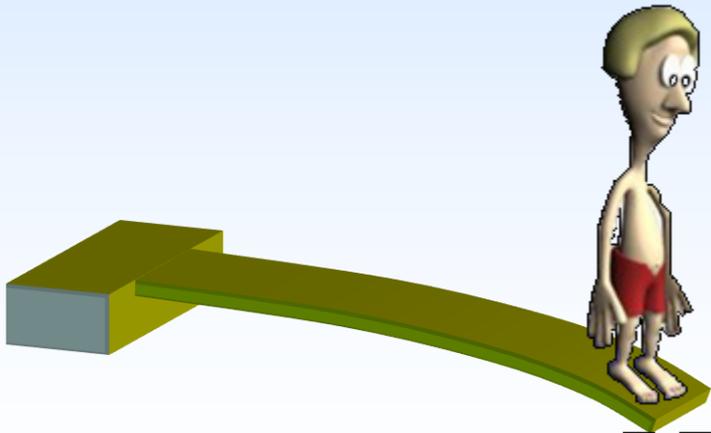
biosensors  
on the tip  
of a fiber





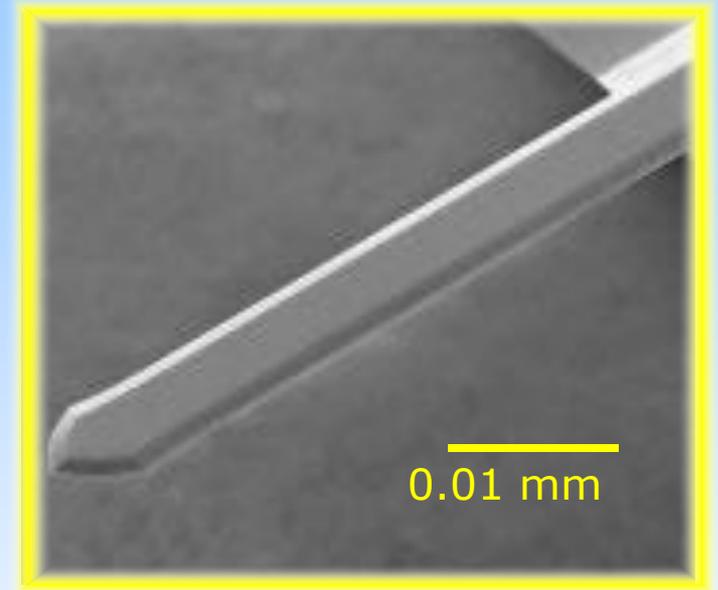
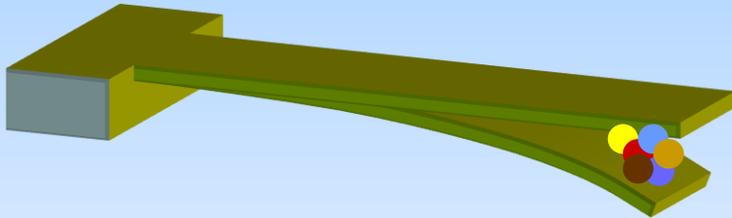
Straight → none is on the board  
Bent → someone is on the board

Bent more  
→ someone heavier is on the board

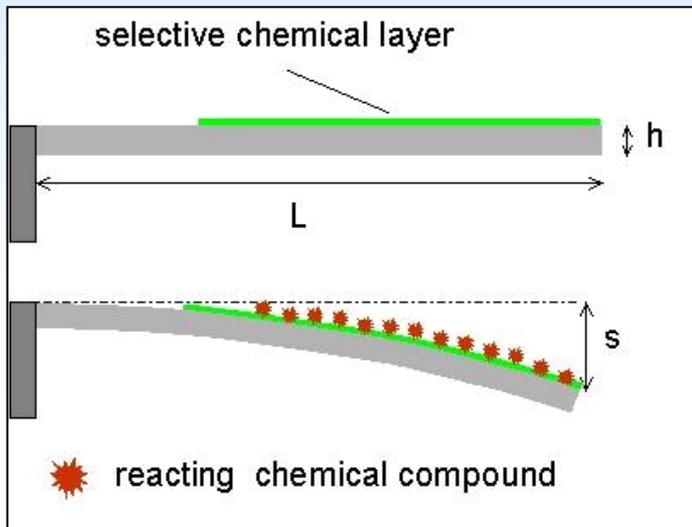


## MICROMACHINED CANTILEVER

A 10,000 times smaller “diving board”



Can we detect a bunch of molecules?



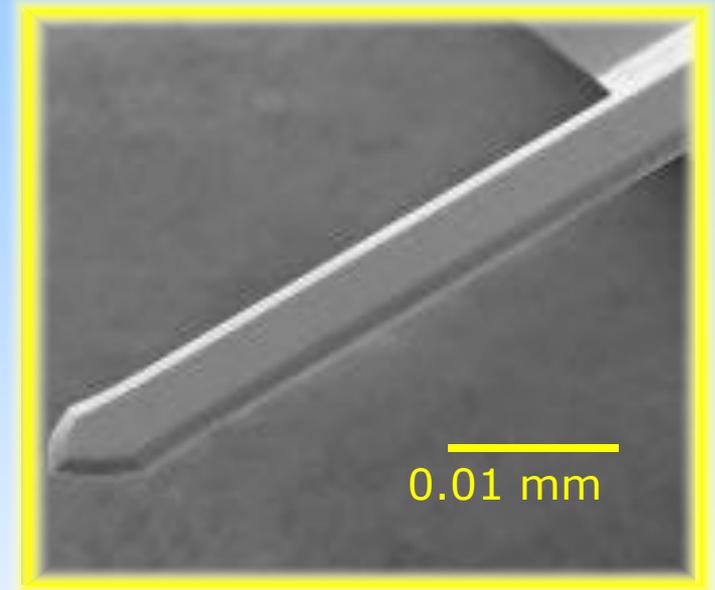
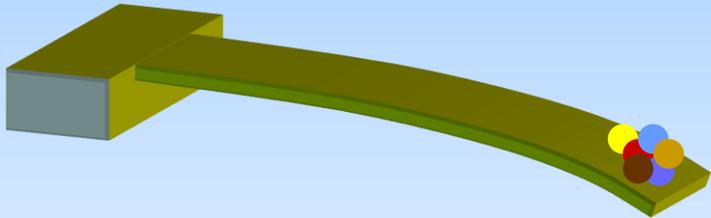
## RESEARCH LABORATORIES

Coat the cantilever with a “sticky tape” that is sticky only for the substance that one wants to detect.

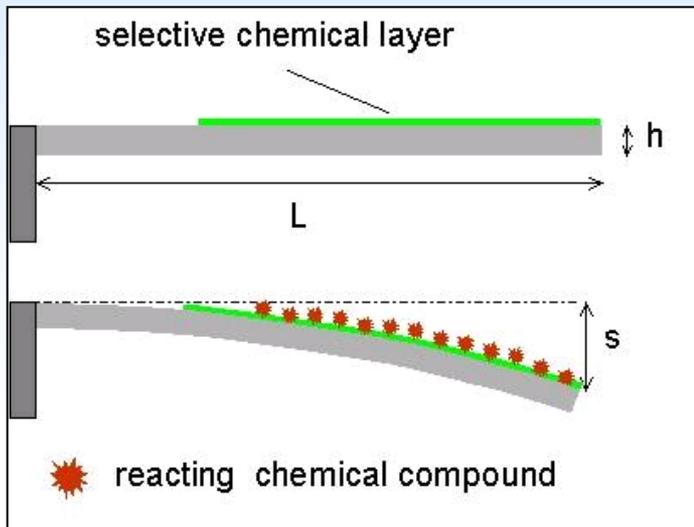
# On a tiny diving board (i.e., on a cantilever)

## MICROMACHINED CANTILEVER

A 10,000 times smaller “diving board”



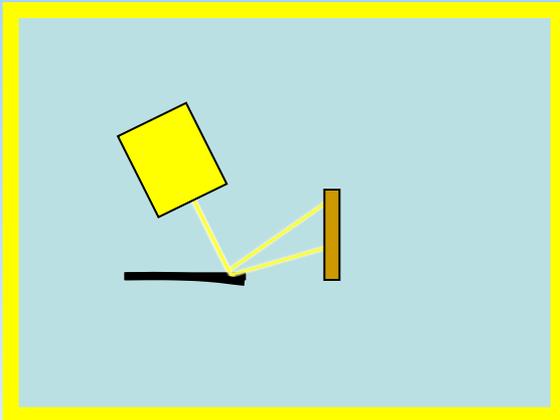
Can we detect a bunch of molecules?



## RESEARCH LABORATORIES

Examples:

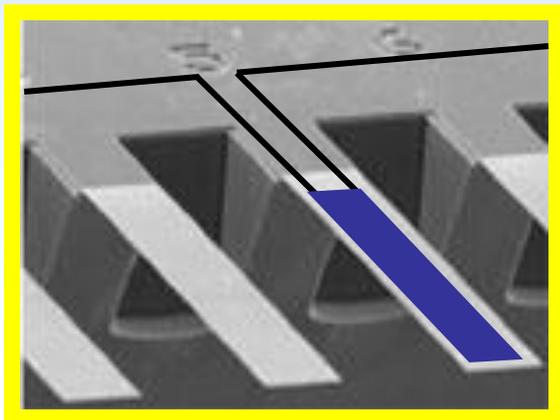
CRP  
PSA  
virus  
bacteria



## OPTICAL READOUTS

Alignment sensitive

Big volume measurements in all sort of environments



## ELECTRONIC READOUTS

Less sensitive

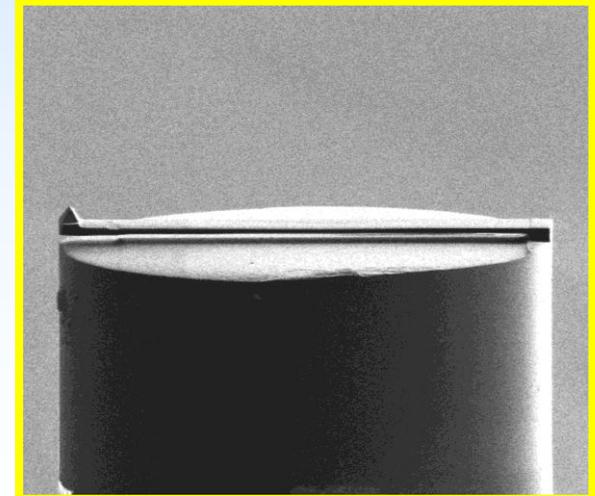
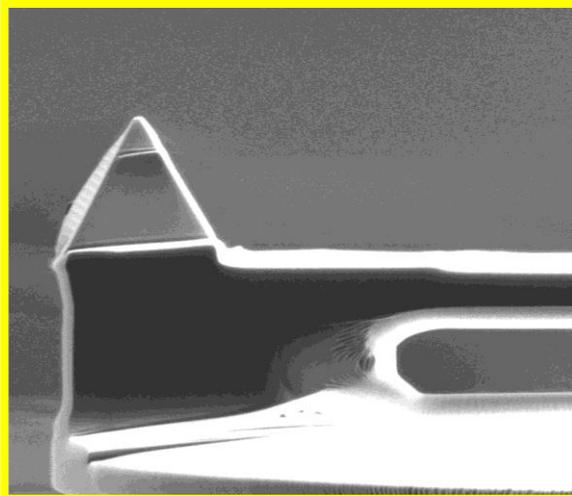
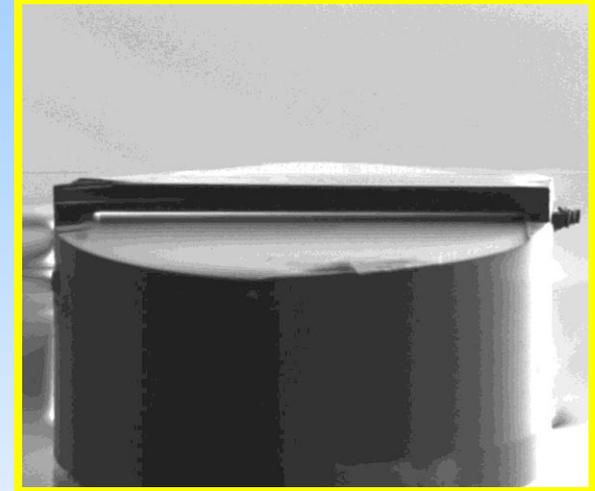
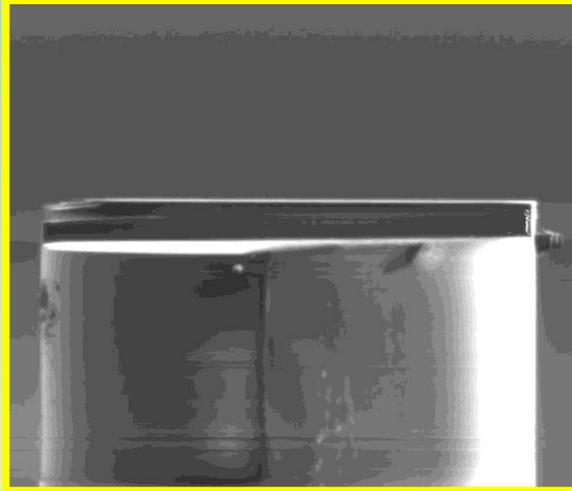
Problems in hostile environments

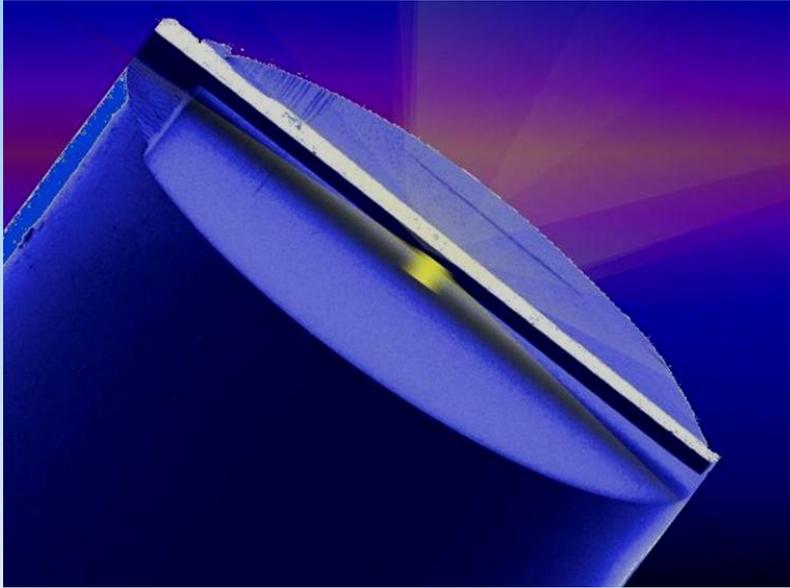


# Solution: fiber-top technology

Single mode  
optical fiber

125  $\mu\text{m}$





**SENSITIVE:** based on optical interference

**FLEXIBLE:** working principle is not affected by the surroundings

**COMPACT:** just on the tip of a fiber

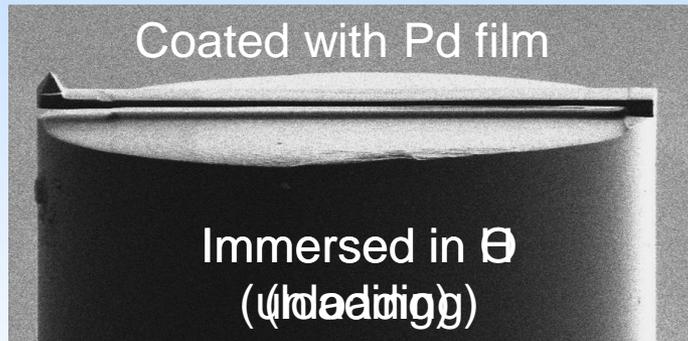
**EASY-TO-USE:** “plug-and-play” design

**PORTABLE:** readout in small volumes and light weight

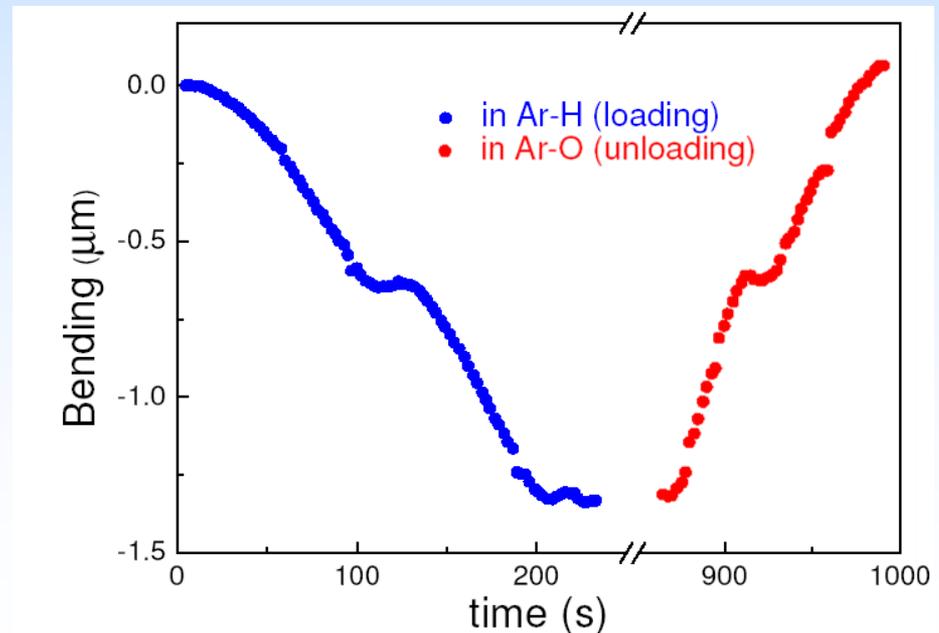
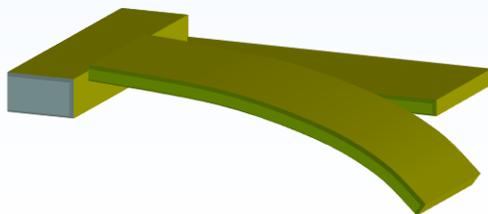


Cantilevers are widely used as biochemical detectors

Can we use fiber-top technology for that too?



mechanical stress



# Fiber-top technology: where is the catch?

Academic research  
(24/7 happy students)



~ one day of work  
per device



technology transfer

Price per device is  
too high



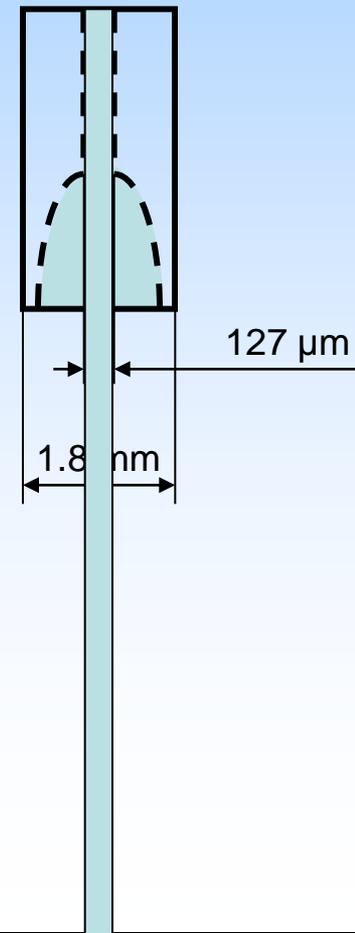
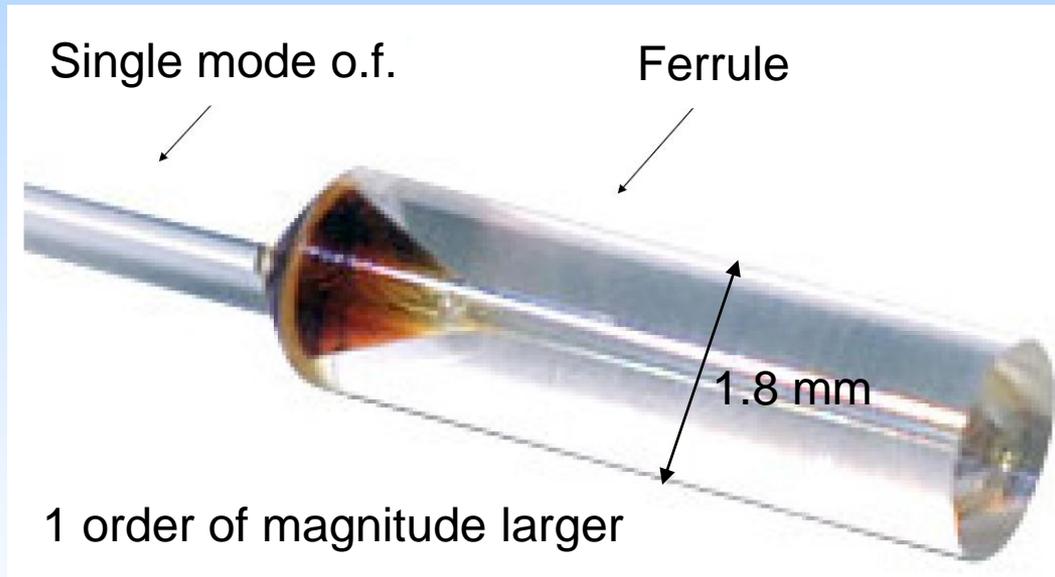
FIND ALTERNATIVE FABRICATION TECHNIQUES  
THAT ADAPT WELL TO SERIES PRODUCTION

# A new approach: ferrule-top devices

A radically different approach:

Limiting factor: the fiber is very small  $\rightarrow$  high cutting resolution

Solution: scale-up!

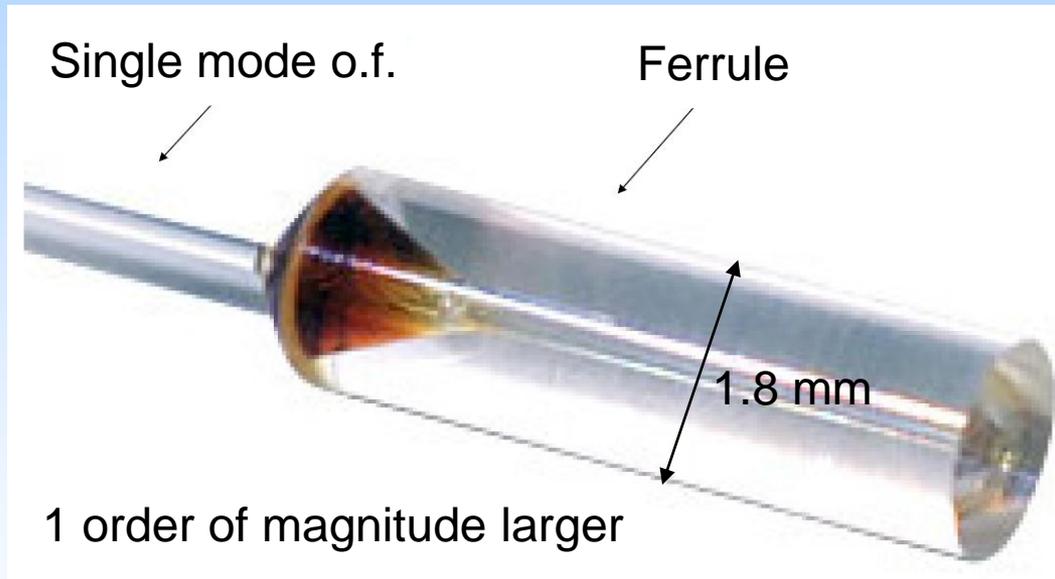


# A new approach: ferrule-top devices

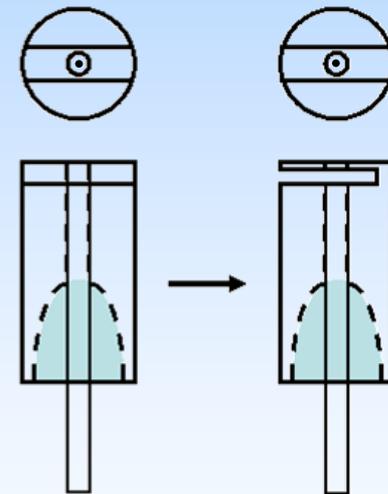
A radically different approach:

Limiting factor: the fiber is very small → high cutting resolution

Solution: scale-up!



MACHINING



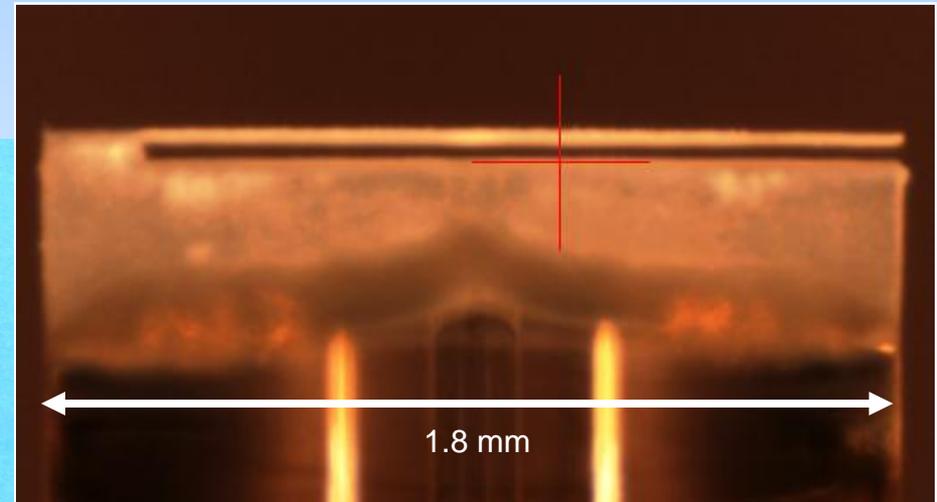
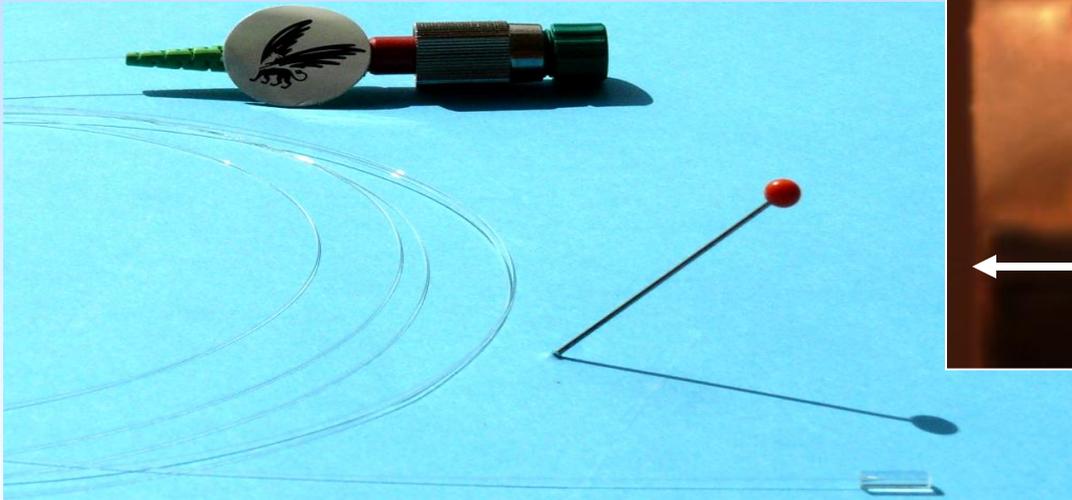
**MORE THAN 1 ORDER OF MAGNITUDE IMPROVEMENT IN FABRICATION COSTS**

# A new approach: ferrule-top devices

A radically different approach:

Limiting factor: the fiber is very small → high cutting resolution

Solution: scale-up!

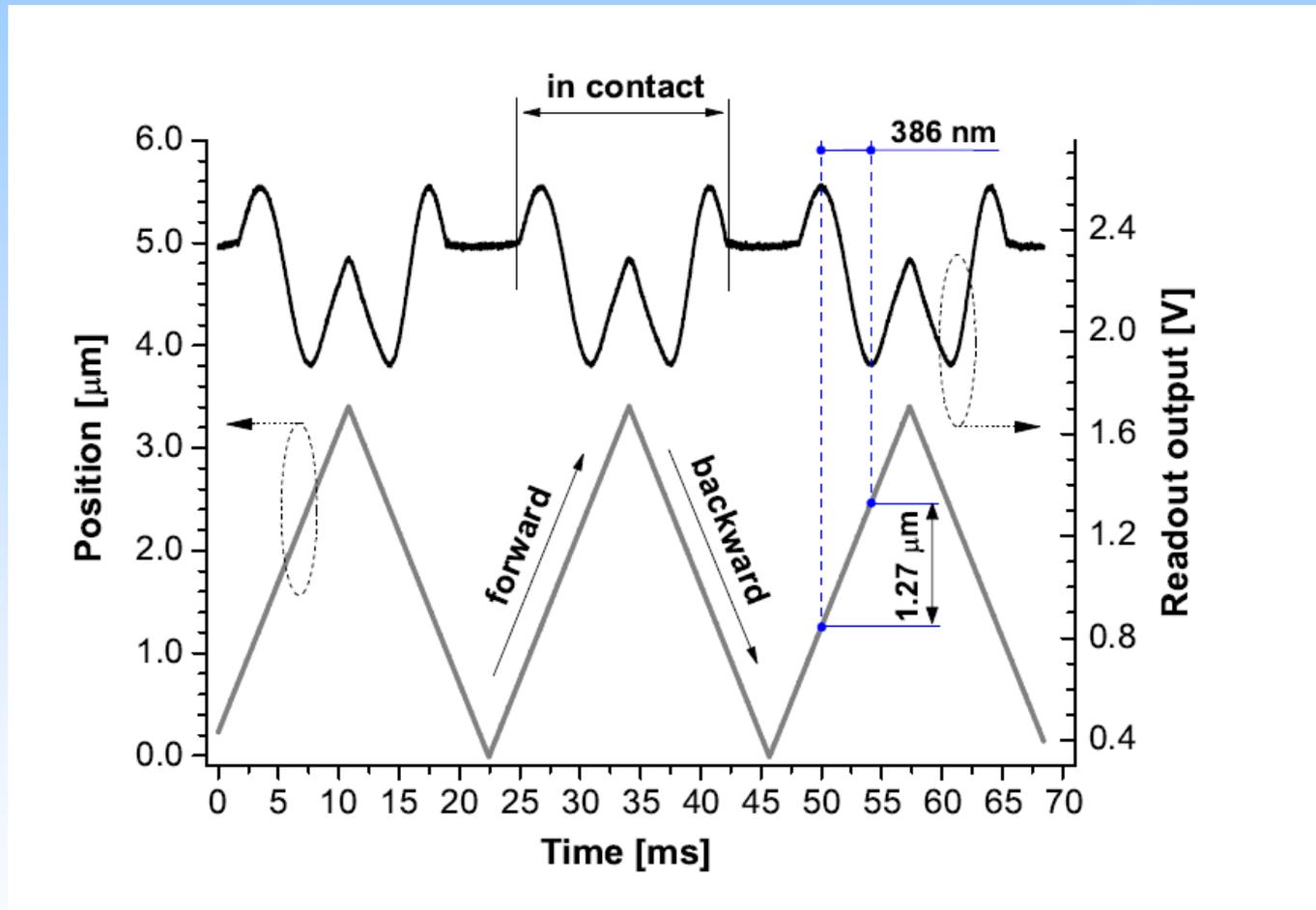
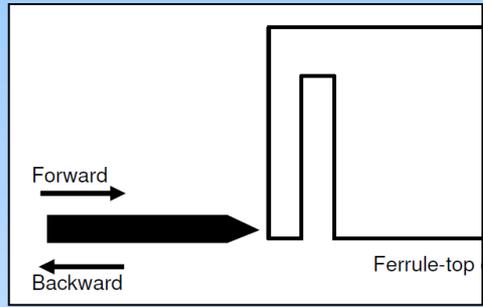


Fabrication: ps-laser ablation

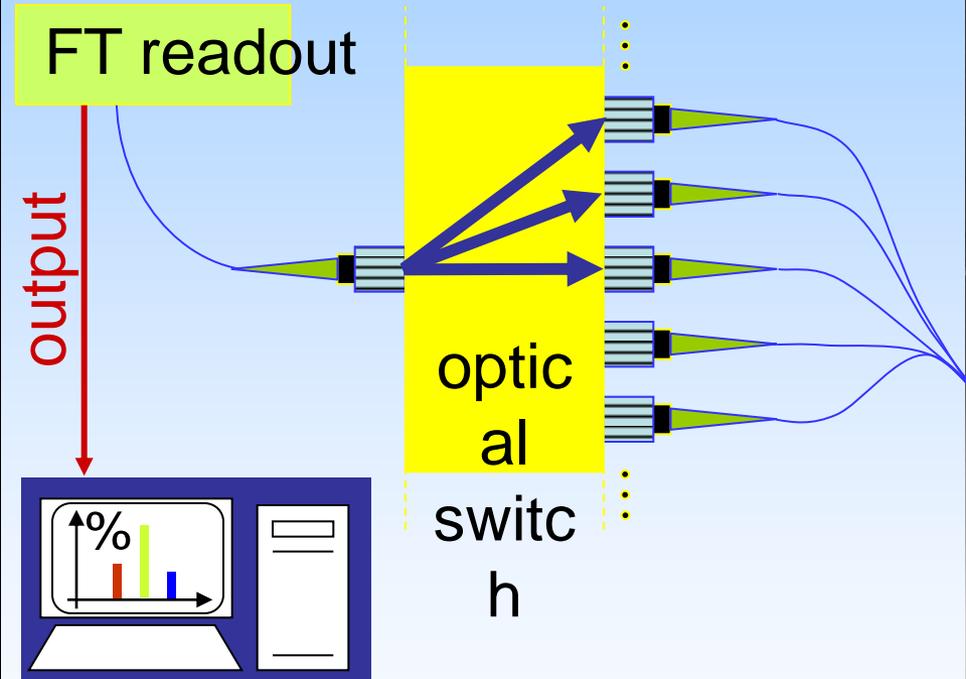
ridge → < 50 min. (not optimized)

undercut → < 10 min. (not optimized)

# Ferrule-top devices: test



# Back to biochemical sensing: future applications



# Fiber-top and ferrule-top

Research laboratories

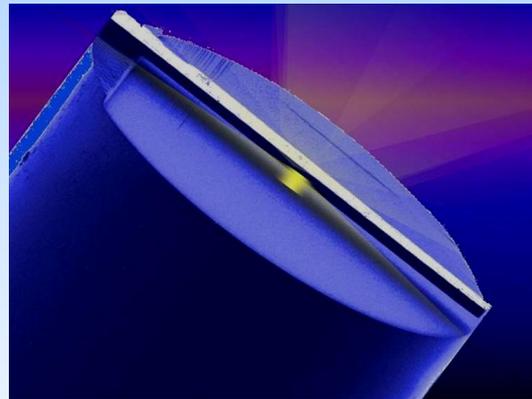


Space missions



Homeland security

Quality inspection



Environmental analysis



Surgery rooms & medical applications

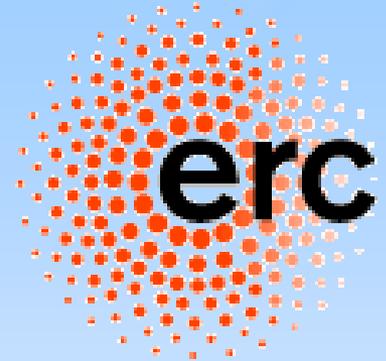
*Thank you for your kind attention*

davide iannuzzi

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