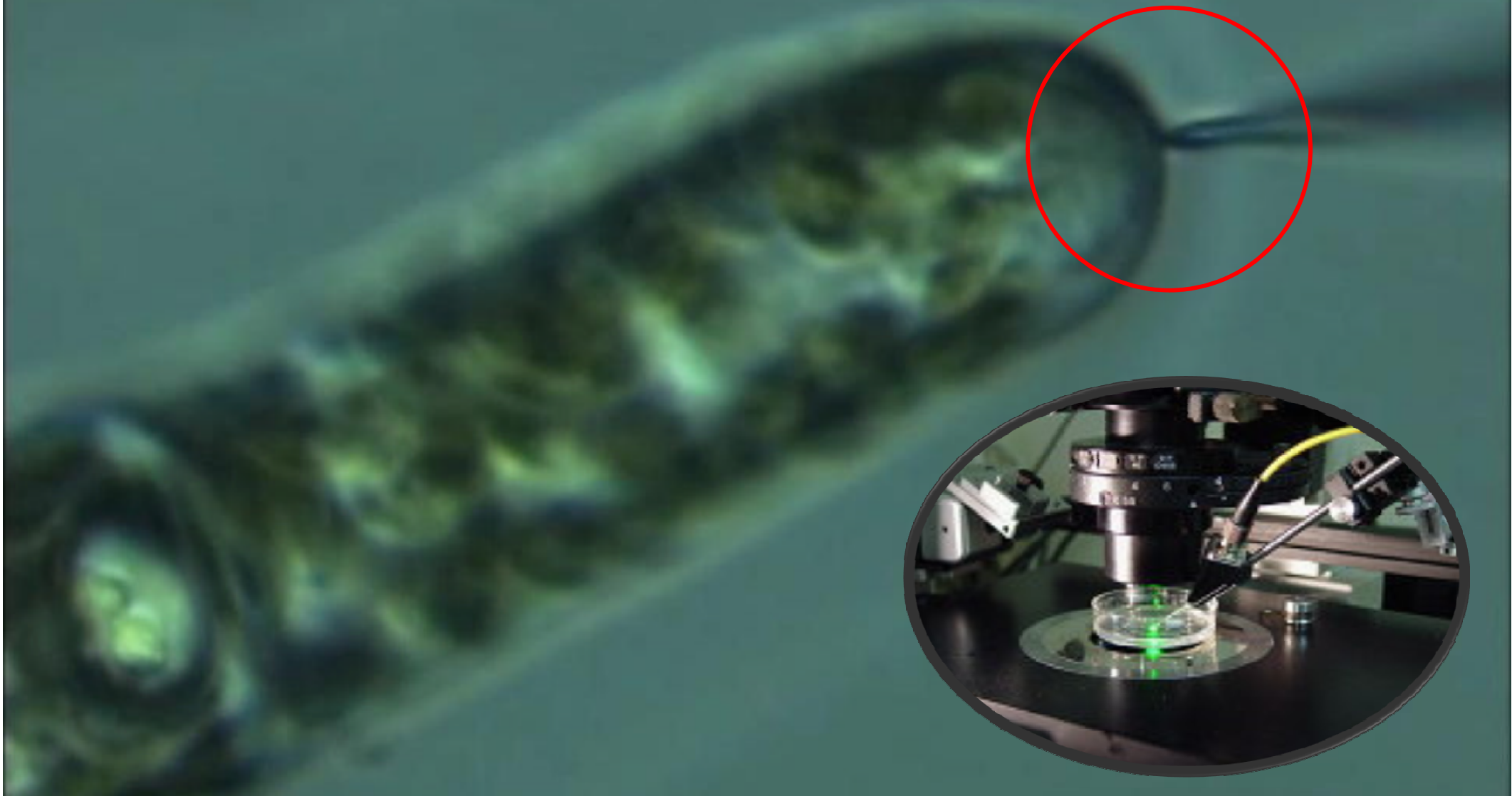
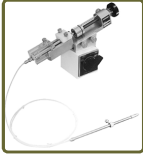



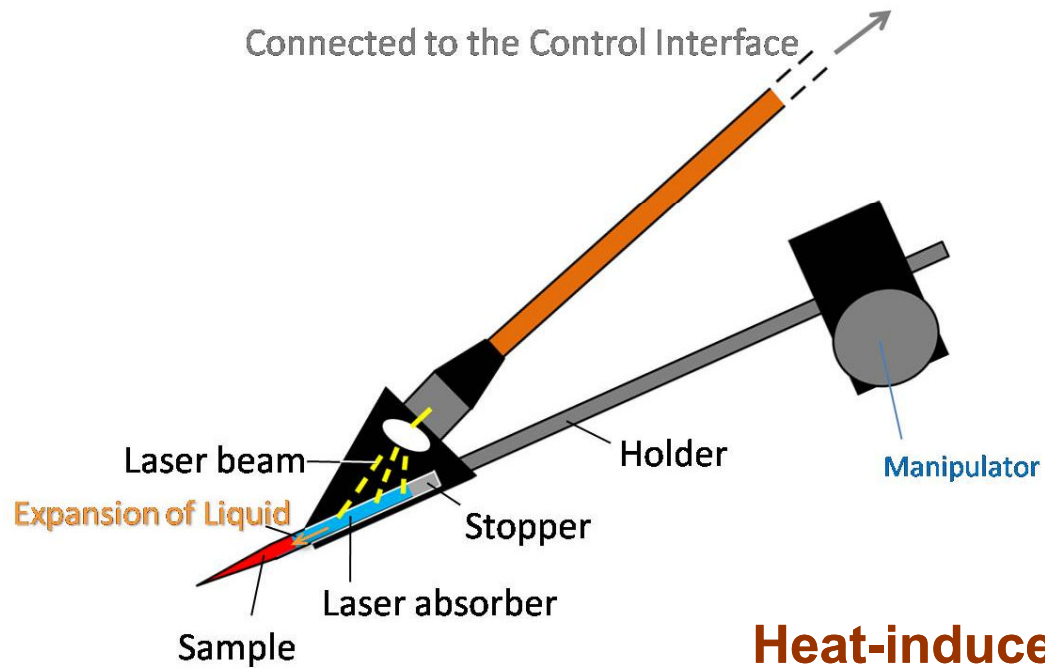
Laser-assisted Thermal-expansion Microinjector LTM-1000



Comparison

	Available Micropipette Tip Dia. Size	Injection into Plant Cells	Pressure Method	Pressure
Conventional Microinjectors 	> 0.7 μm *A holder can not hold the micropipette with a smaller diameter tip than about 0.7 μm .	N/A	Oil or Gas	Max. 2 MPa
LTM-1000 	> 0.1 μm	Available	Thermal Expansion	1 MPa per Degrees C

LTM-1000 : Structure



LTM-1000

Heat-induced expansion of liquid in a sealed micropipette generates high pressure.

Isothermal Compressibility:

$$\kappa = -1/V(\partial V/\partial P)_T$$

Cubic Thermal Expansion:

$$\alpha = 1/V(\partial V/\partial T)_P$$

Ejection Pressure:

$$\partial V/\partial T = (\partial P/\partial V)(\partial V/\partial T) = \alpha/\kappa$$

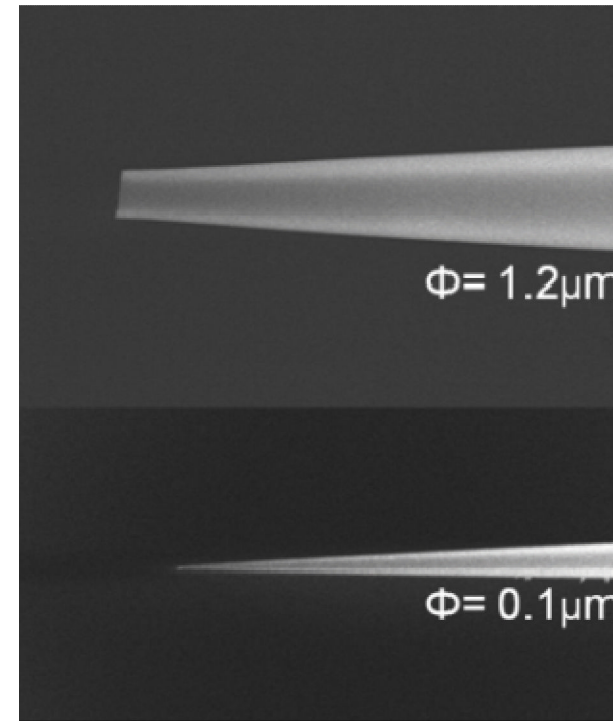
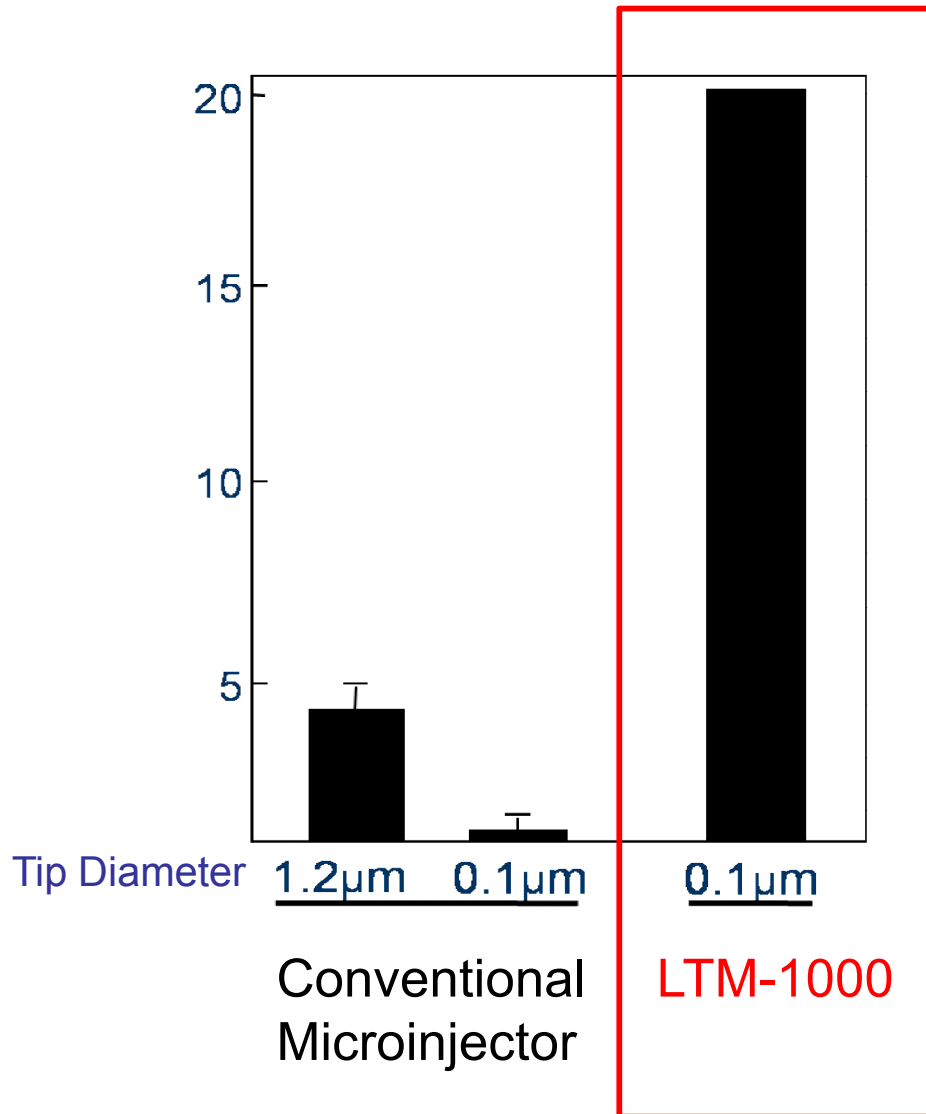
$$\cong (10^{-3}/^{\circ}\text{C})/(10^{-3}/\text{MPa}) = 1 \text{ MPa}/^{\circ}\text{C}$$

<Features>

Make It Possible to

- Inject into Plant Cells
- Use the Micropipette with 0.1 um Dia. Tip

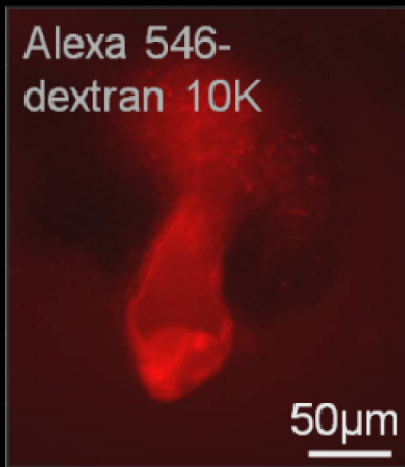
Number of Injections into Plant Cells with A Single Micropipette



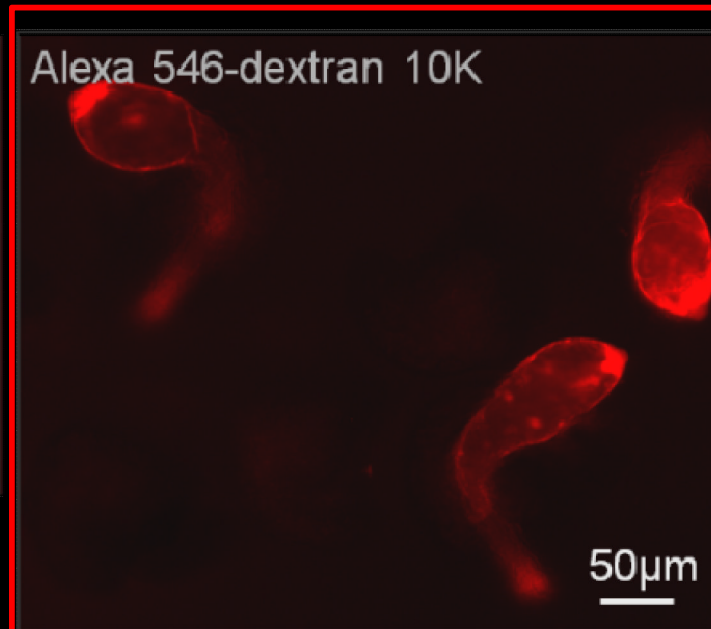
Size Difference in Micropipette Tips

Plant Cells & Small Cells

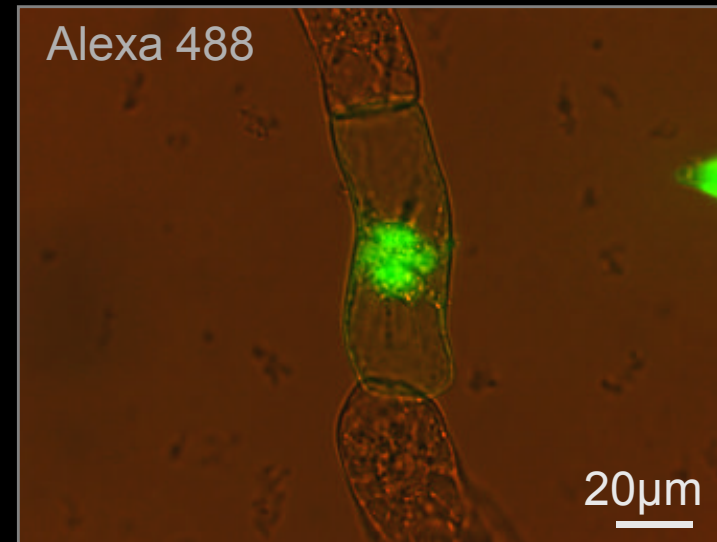
Injection into the female gametophyte of plant



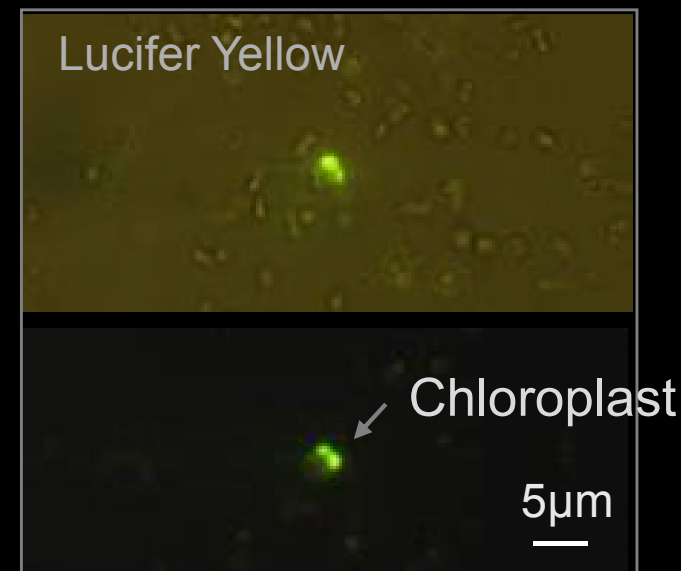
Conventional Method
- Damaged
- Sample Escape



LTM-1000
with a Fine Tip Pipette
- No Damaged
- No Sample Escape
- Continuous Injections



Injection of antibody into plant cells



Injection into chloroplasts of *Cyanidioschyzon merolae*