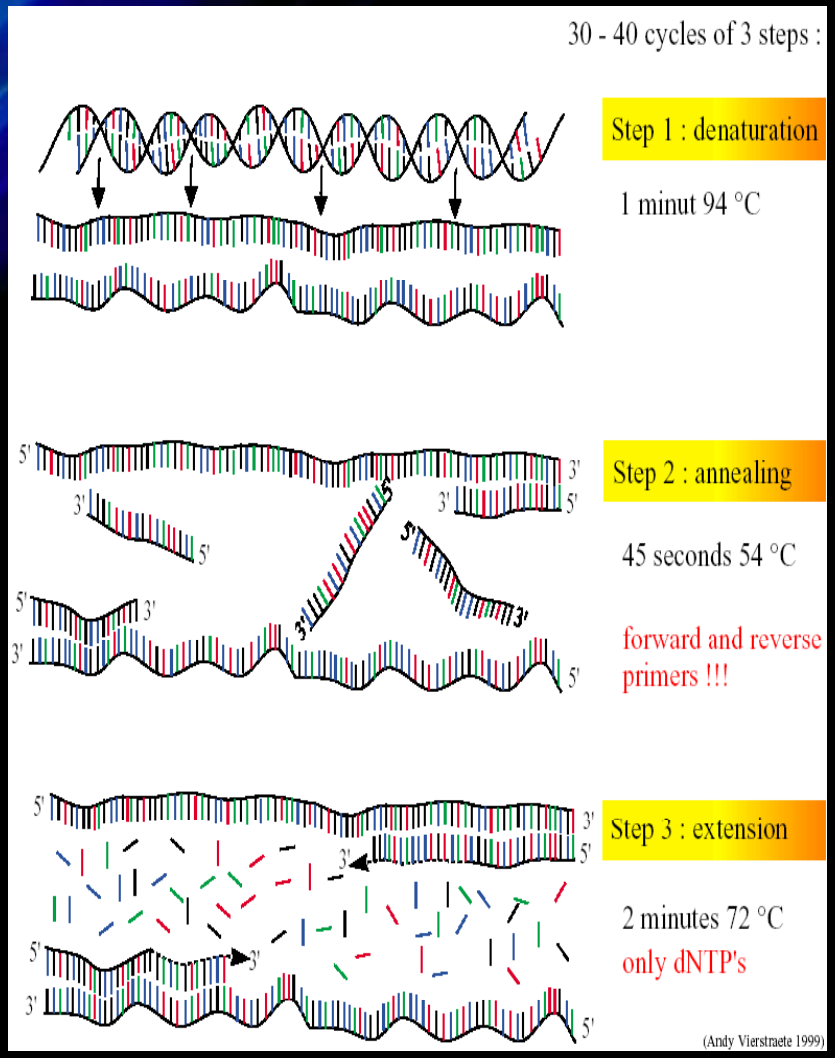
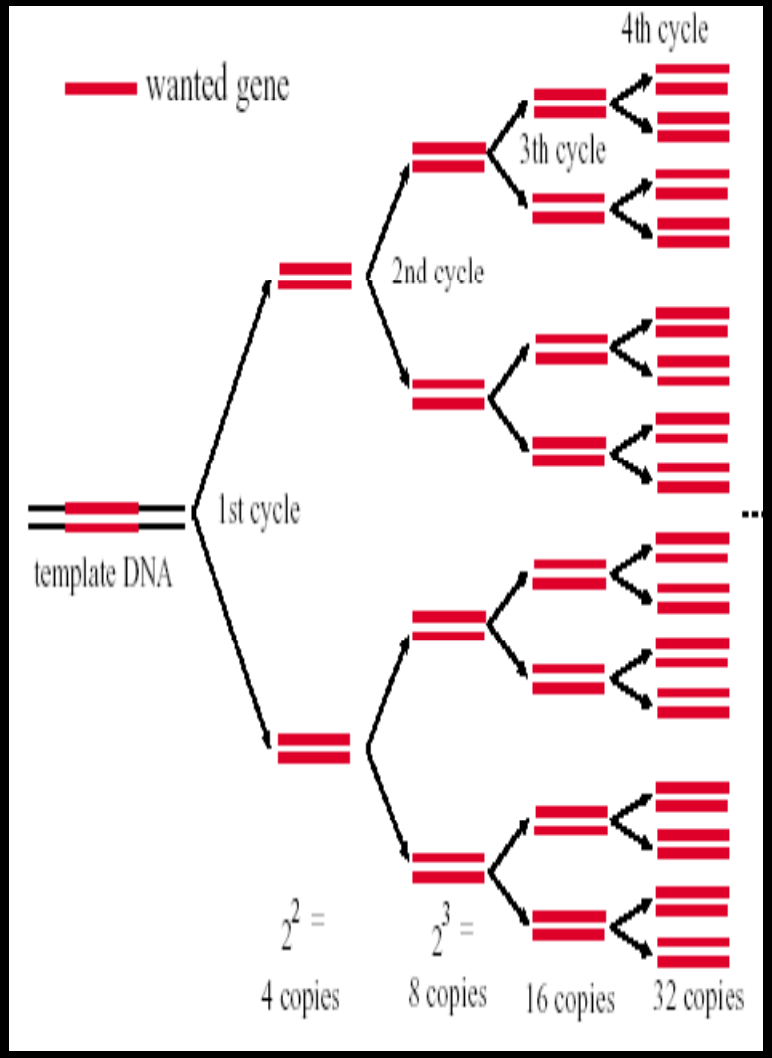
PCR on a Chip

PCR

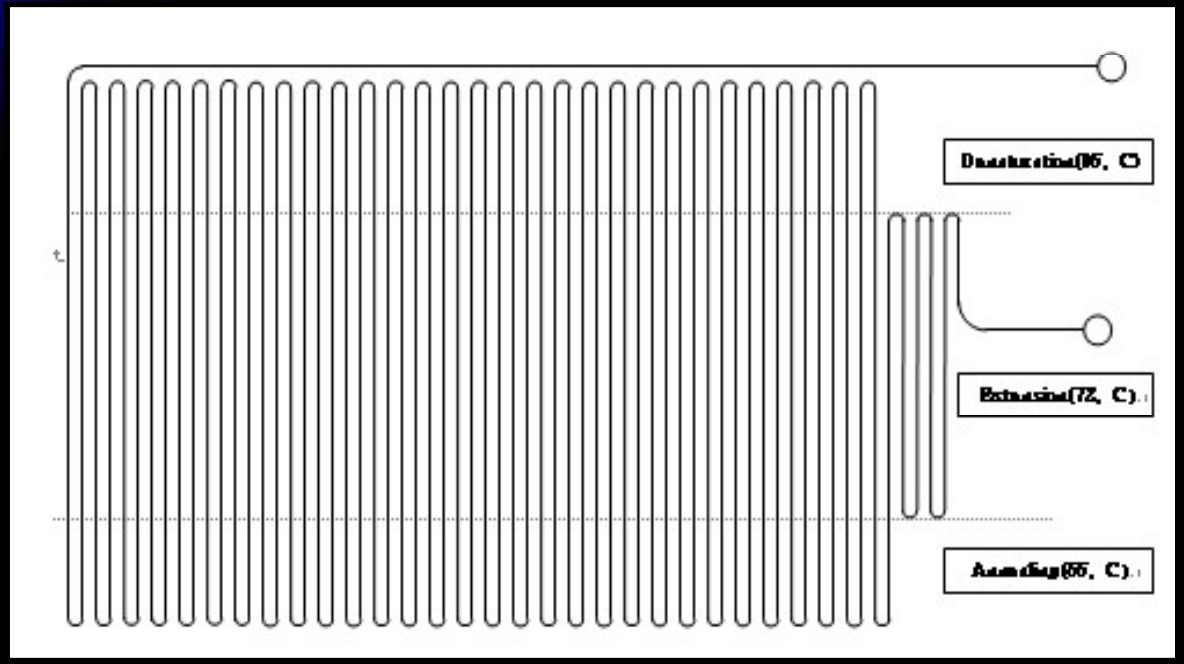

30 - 40 cycles of 3 steps :
Step 1 : denaturation
1 minut 94 °C
Step 2 : annealing
45 seconds 54 °C
forward and reverse primers !!!
Step 3 : extension
2 minutes 72 °C
only dNTP's
(Andy Vierstraete 1999)


4th cycle
wanted gene
3th cycle
2nd cycle
1st cycle
template DNA
2^2 =
2^3 =
4 copies
8 copies
16 copies
32 copies

연속 흐름식 PCR의 장점 (DNA 증폭반응)

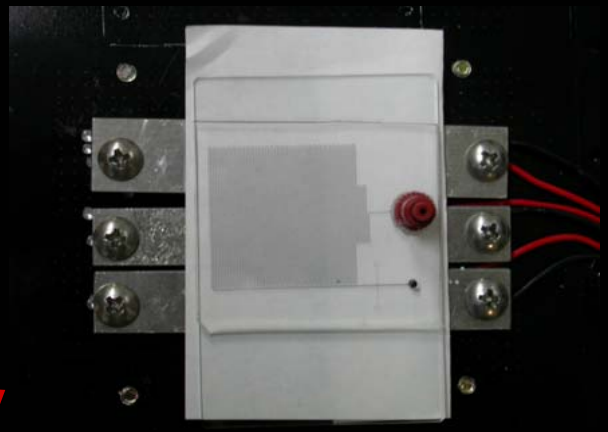
- Conventional PCR에 비해
  - 더 작고
  - 더 빠르고
  - 더 경제적 (작은 양의 시약 소모)

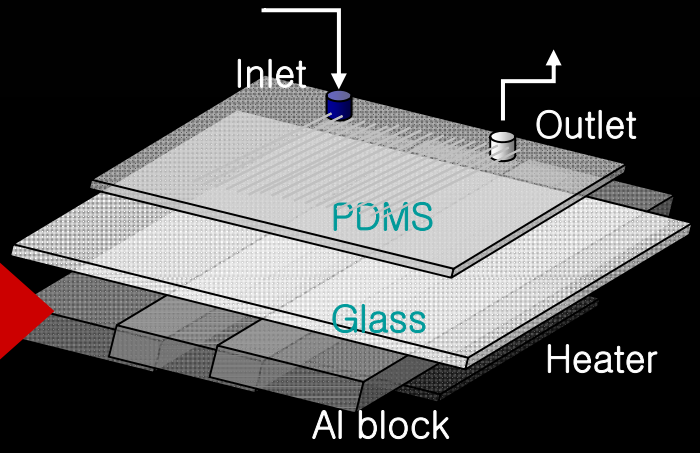
연속 흐름식 DNA 증폭 반응을 위한 마이크로 패턴 디자인



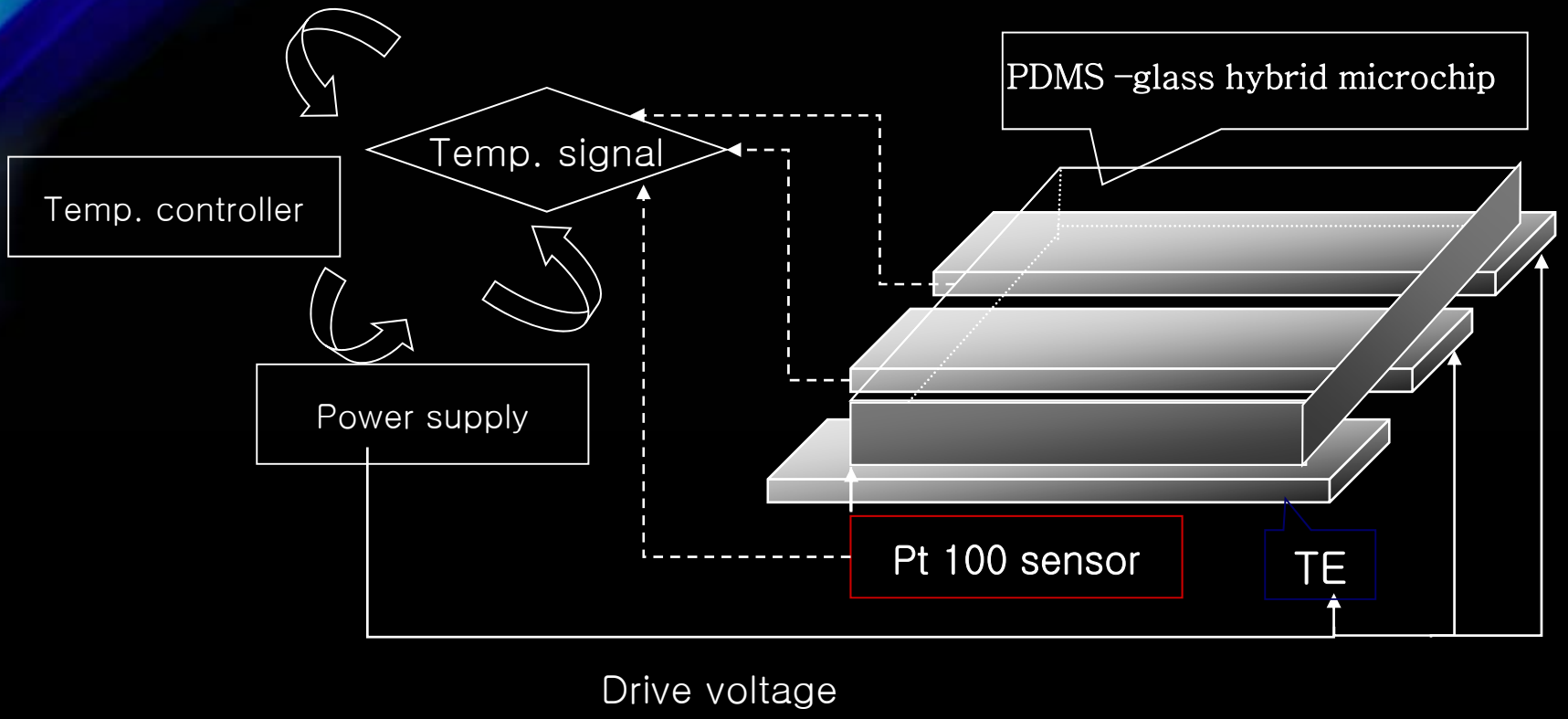
- Channel dimension : 200㎛(W)×75㎛(D)×2m(L)
- Overall chip dimension : 30 mm×30 mm
- Number of cycles : 30

연속 흐름식 PCR을 위한
유체 흐름 제어 장치 및 주변장치

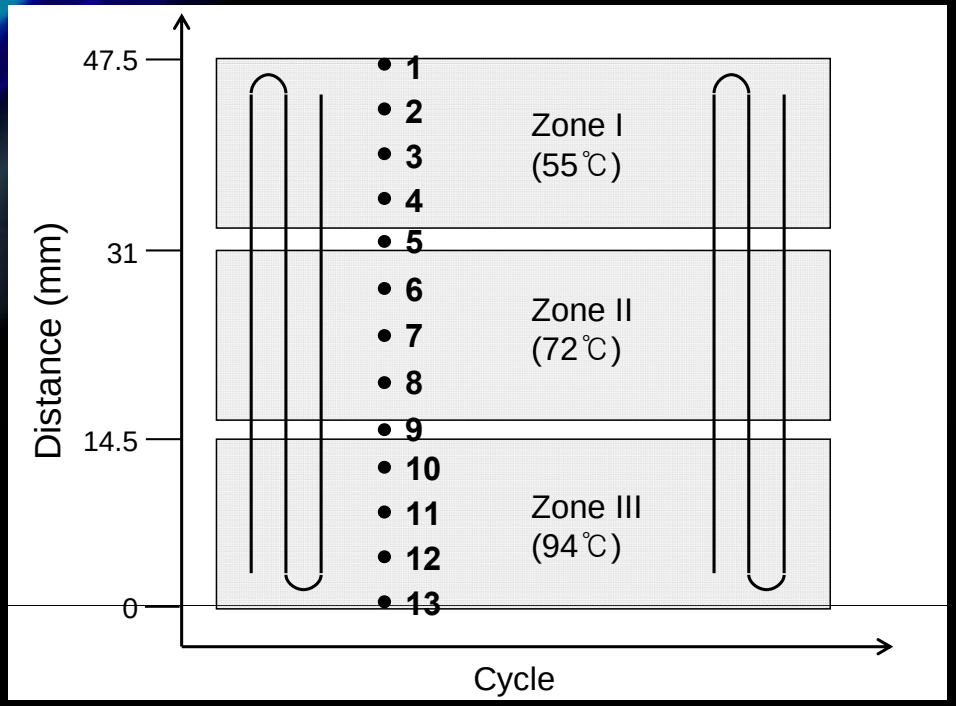


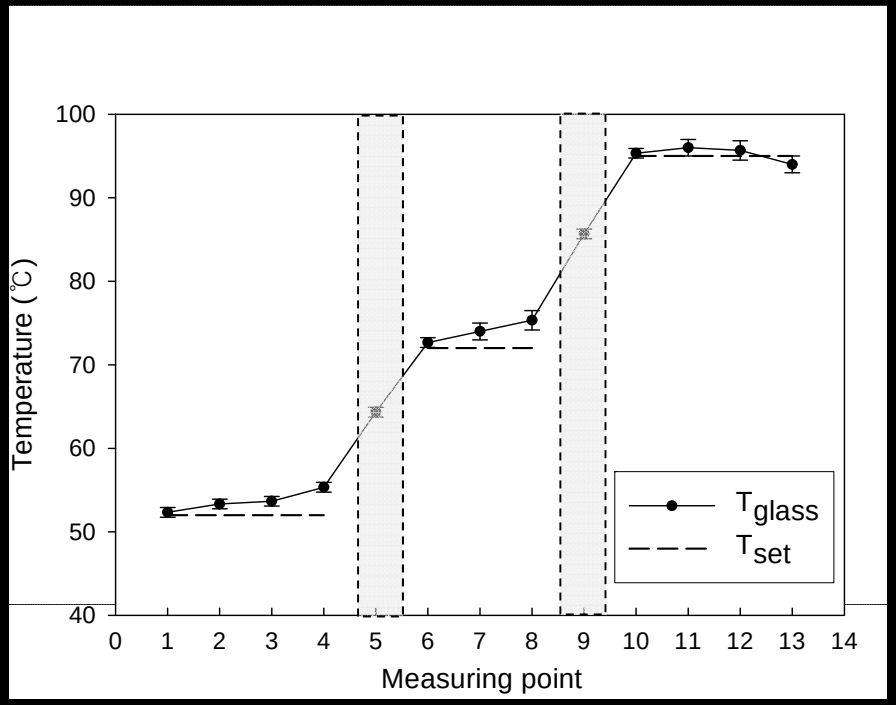


Temperature control system

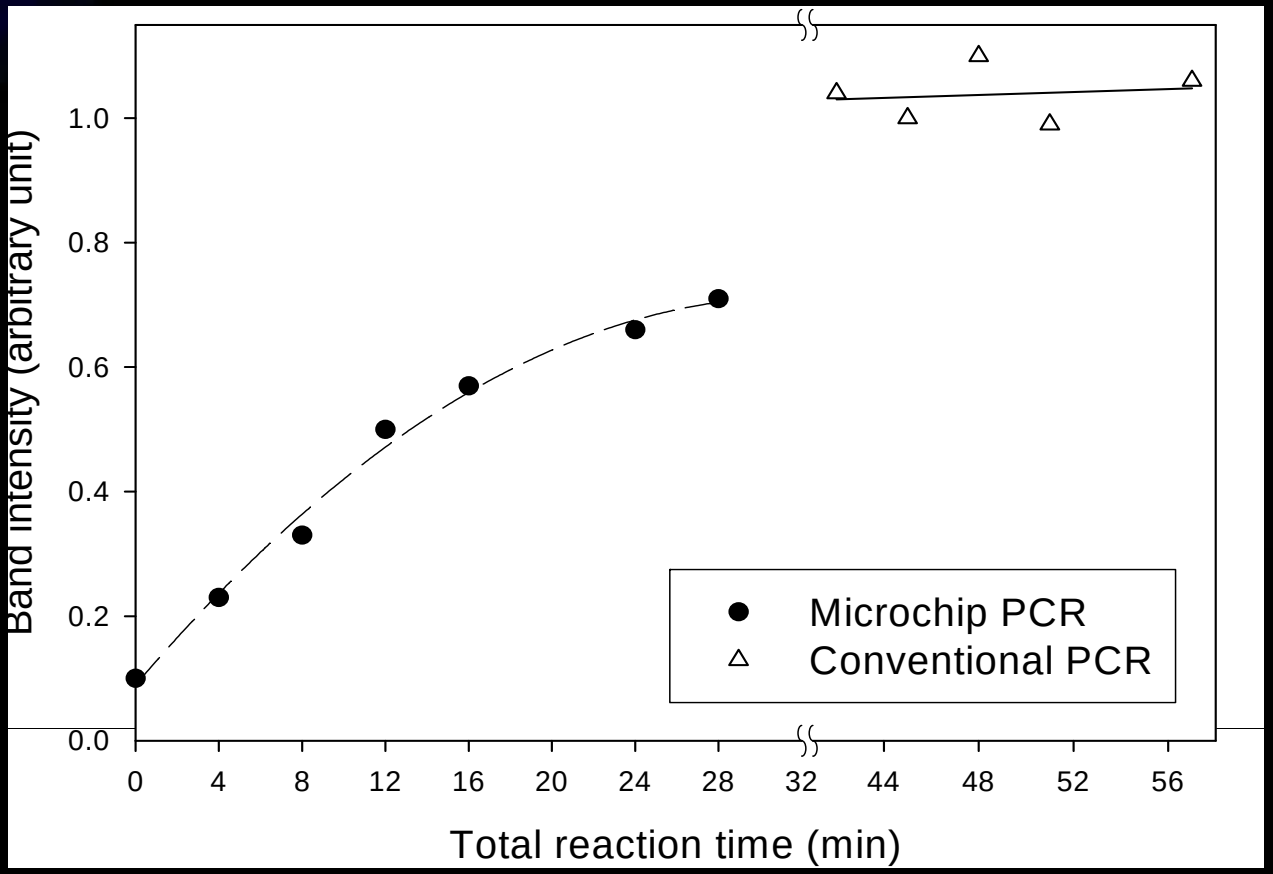


Temperature distribution in μ-PCR chip



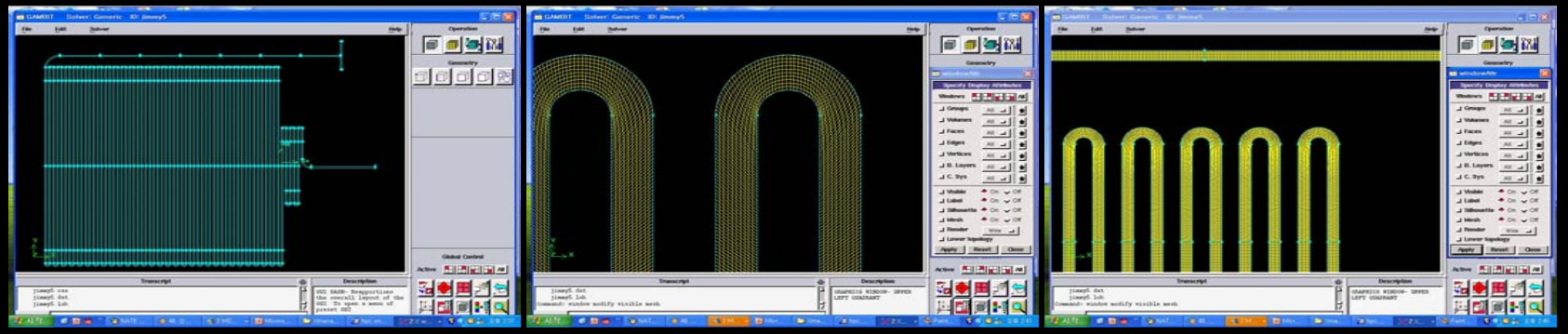


Final DNA band intensities vs. PCR time

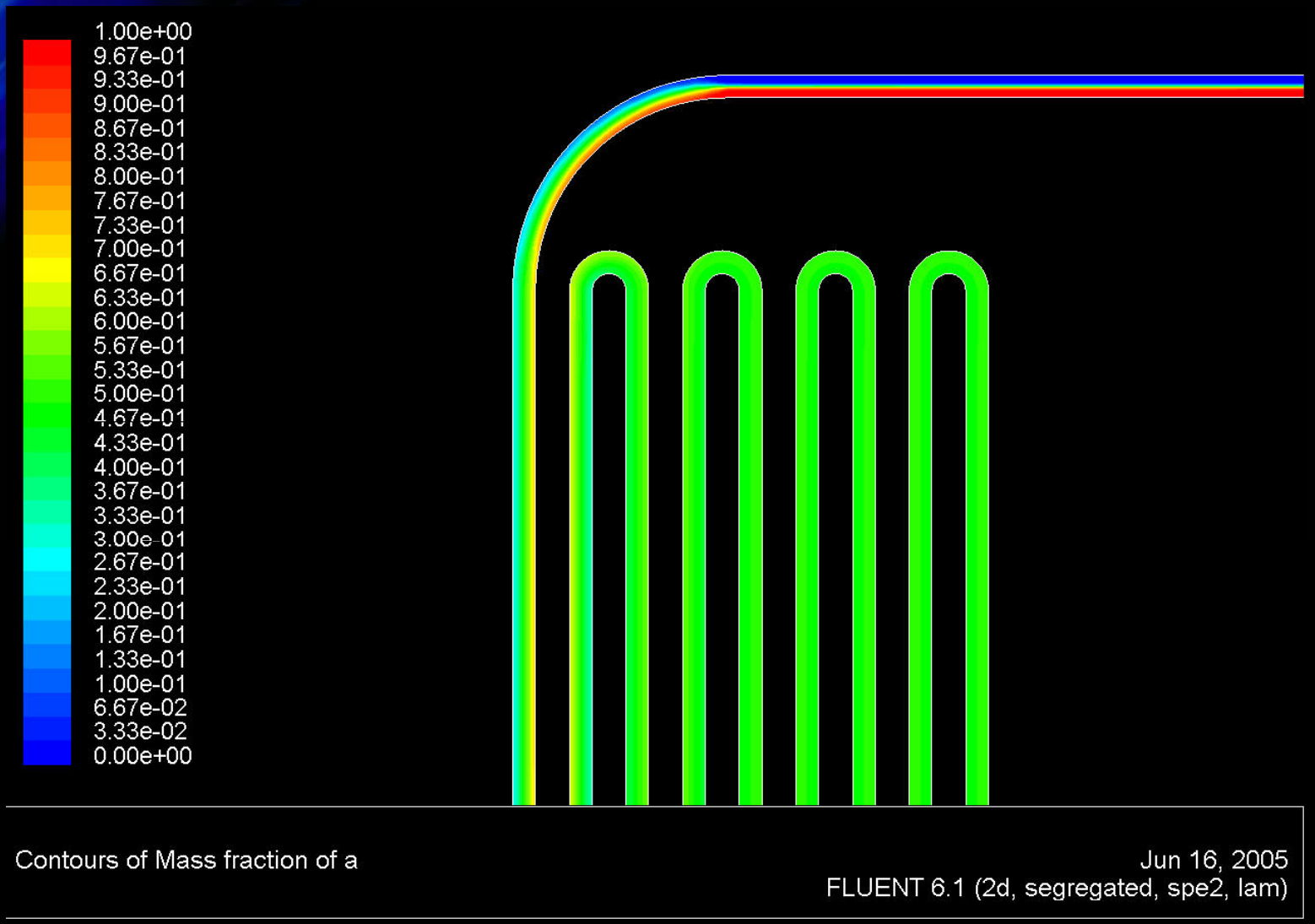


연속 흐름식 PCR에 유체 혼합 기술 적용

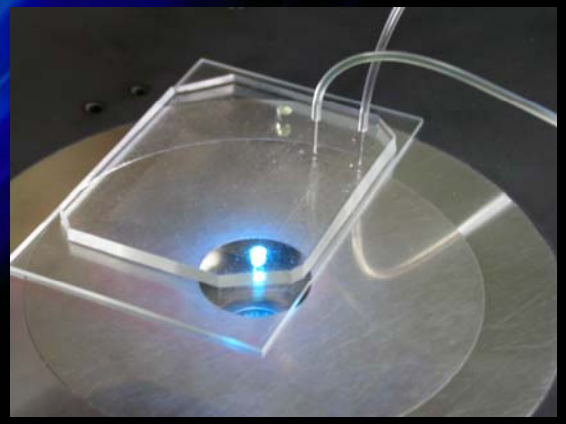
- 시뮬레이션 및 실험 결과
  -- 채널의 길이가 충분히 길어서 미세유체 혼합기술의 적용이 불필요함

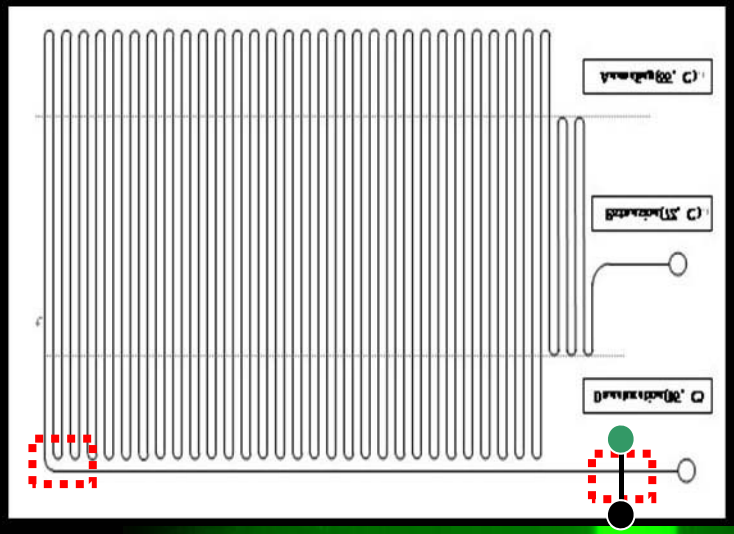


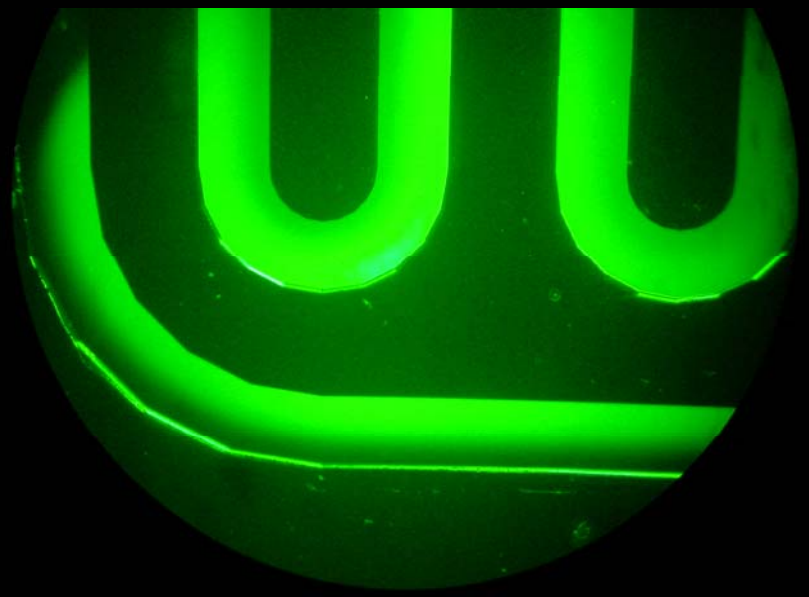
연속 흐름식 PCR칩에서의 시뮬레이션 결과

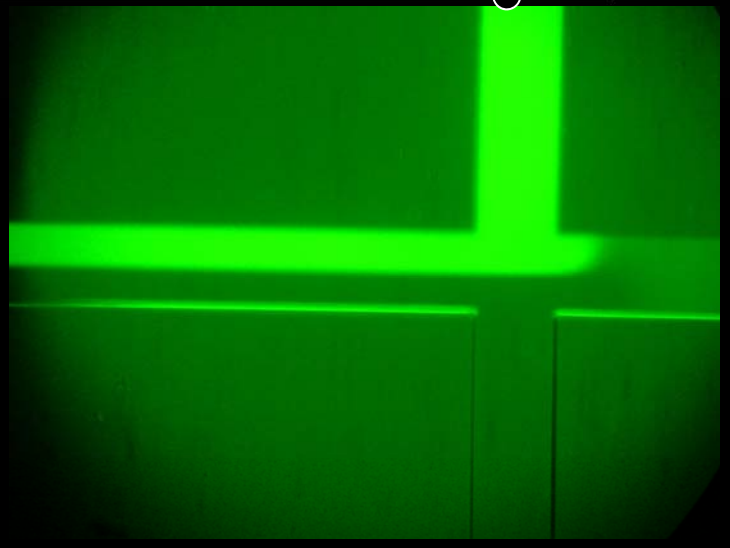


연속 흐름식 PCR칩에서의 실험 결과

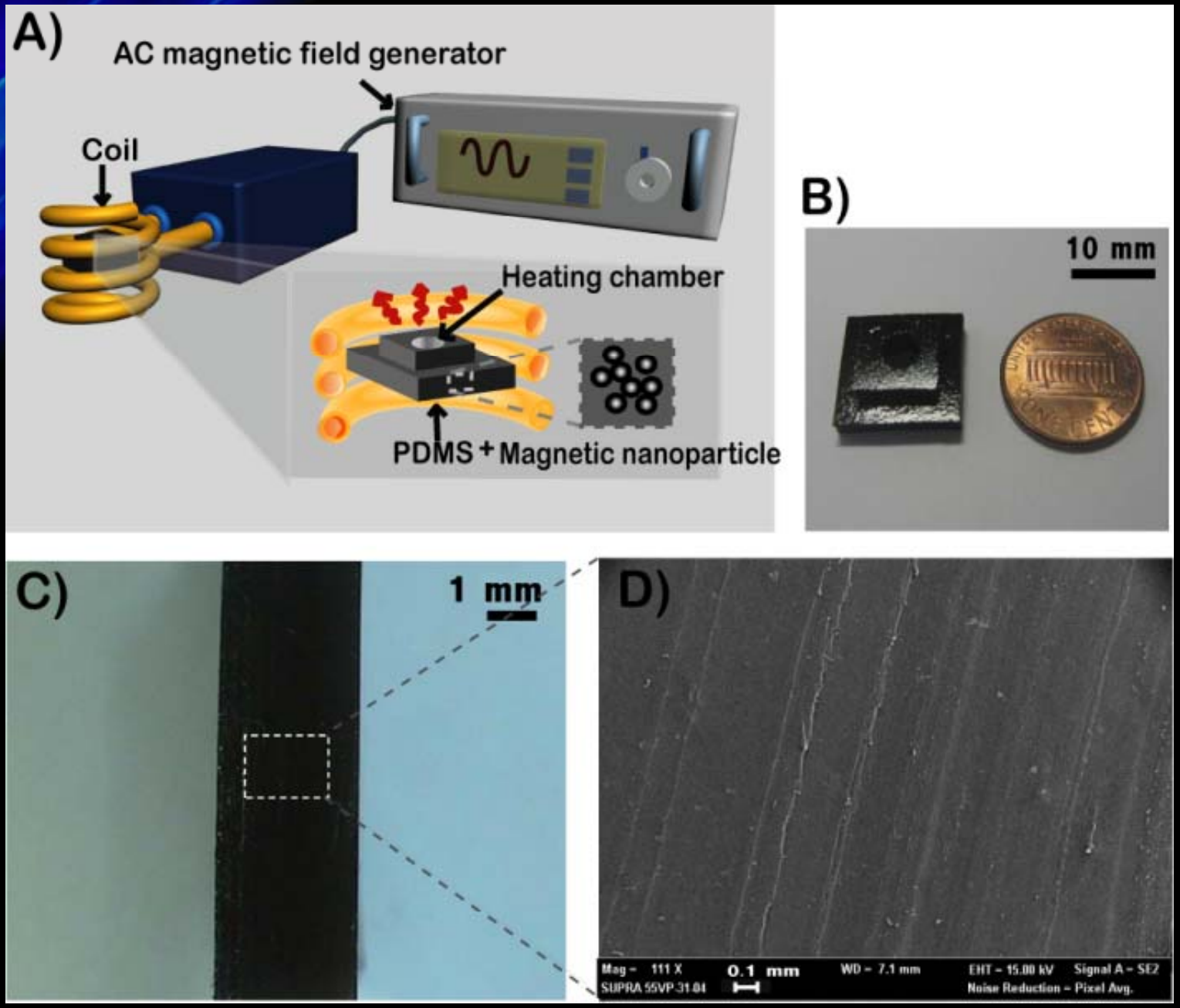


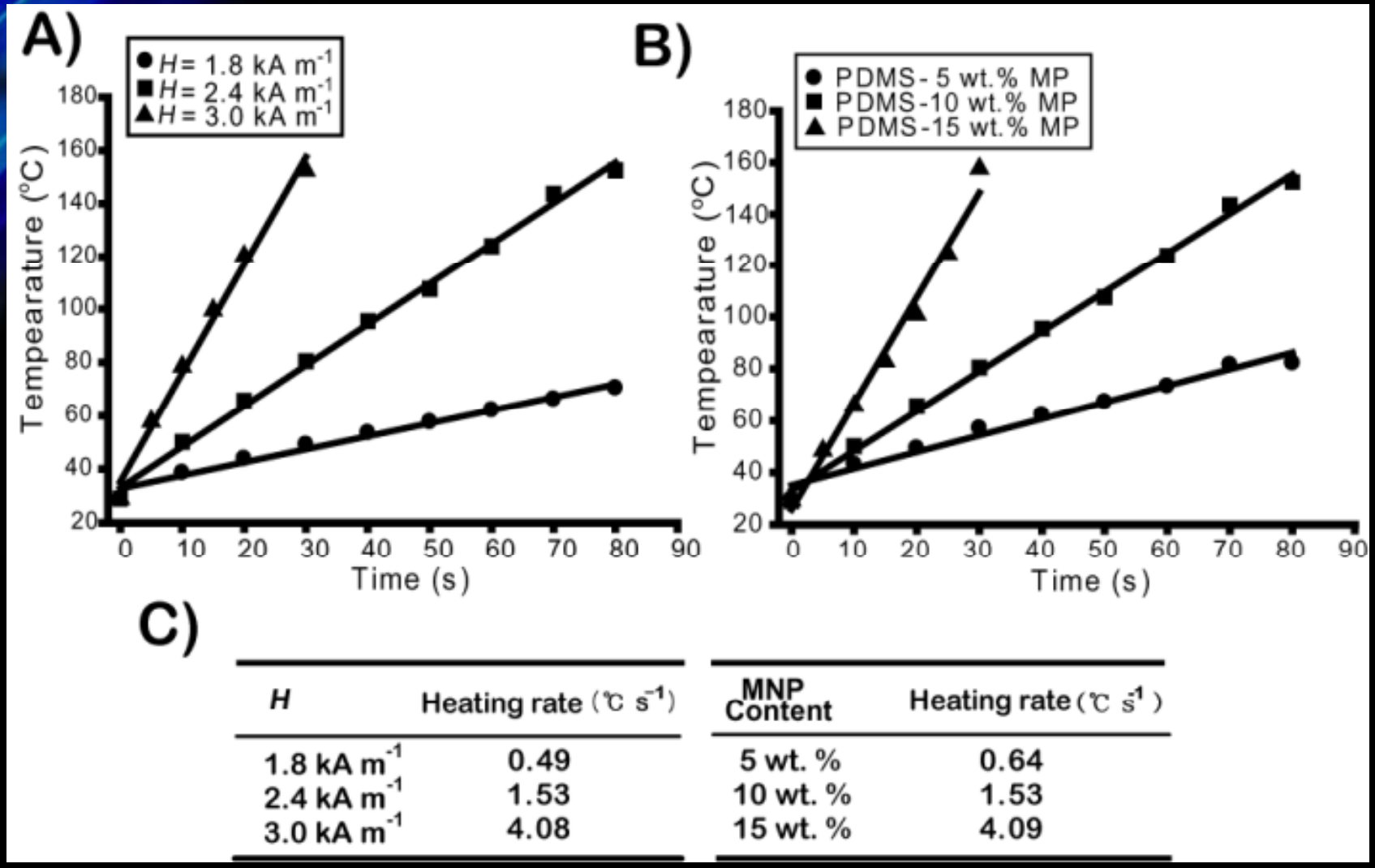






Microheater Based on Magnetic Nanoparticle-Embedded PDMS

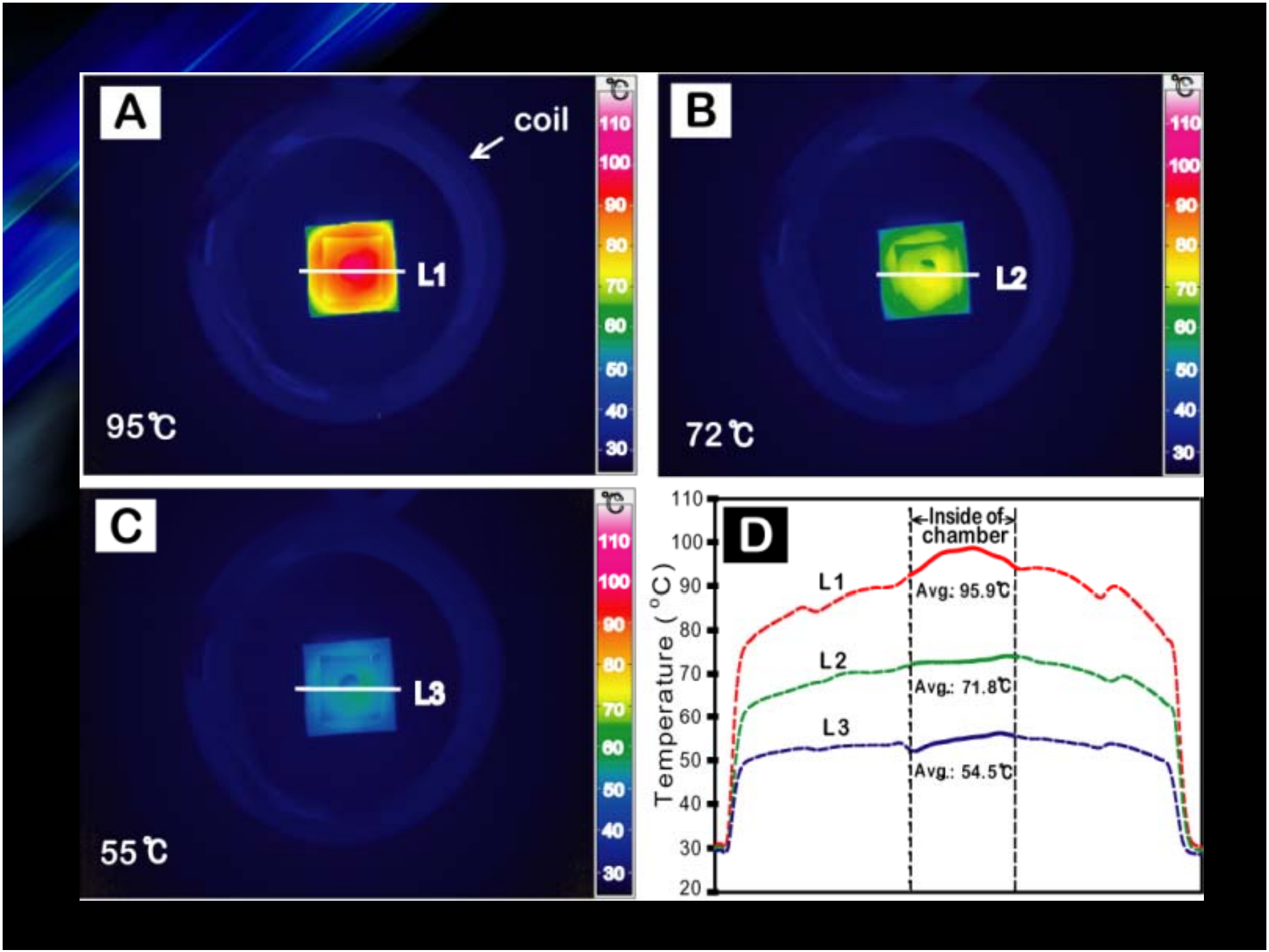

A)
AC magnetic field generator
Coil
Heating chamber
PDMS + Magnetic nanoparticle
B)
10 mm
C)
1 mm
D)
Mag = 111 X
SUPRA 55VP 31.84
0.1 mm
WD = 7.1 mm
EHT = 15.00 kV
Signal A = SE2
Noise Reduction = Pixel Avg.

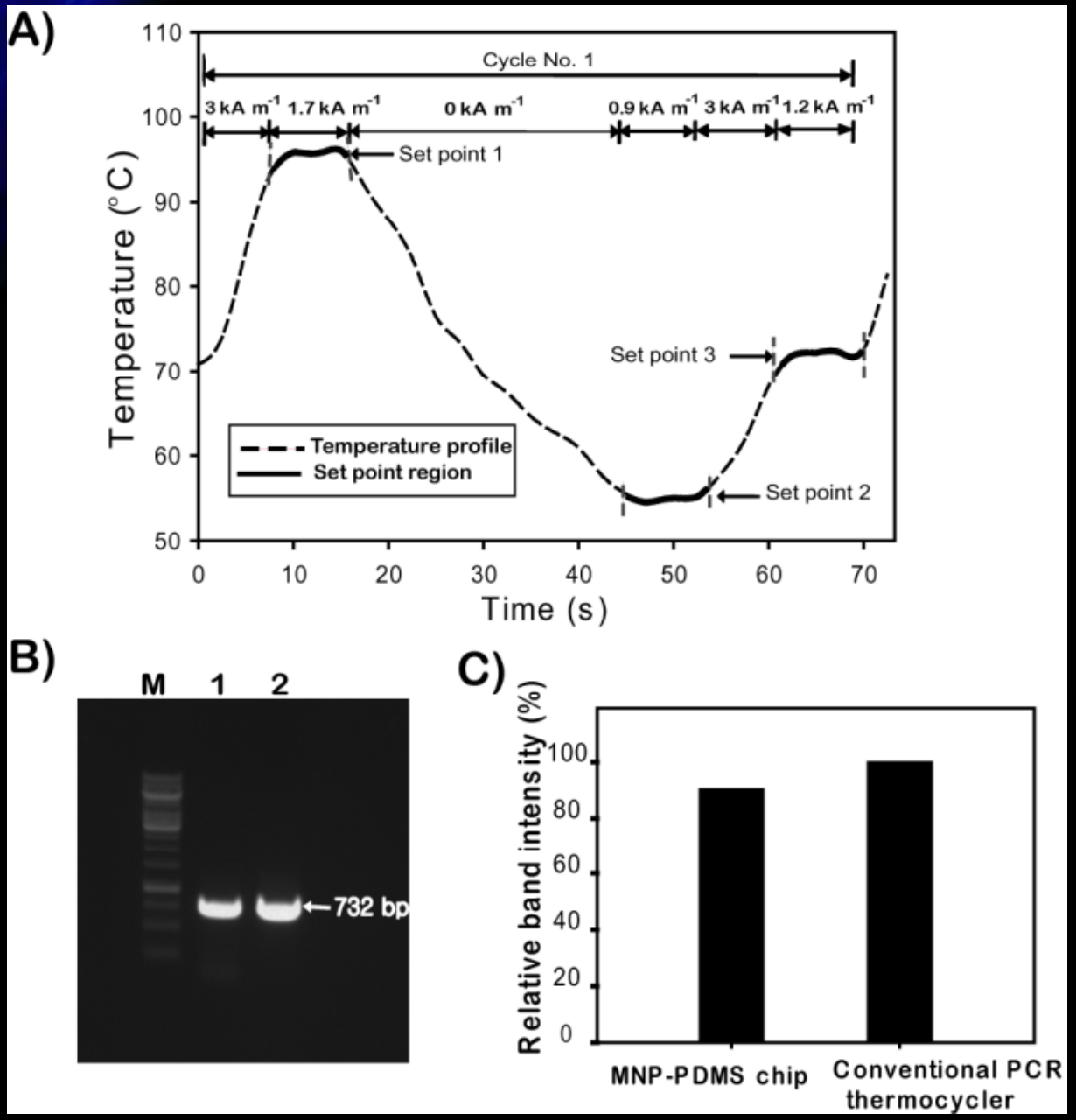


C)

H	Heating rate (℃ s^{-1})
1.8 kA m^{-1}	0.49
2.4 kA m^{-1}	1.53
3.0 kA m^{-1}	4.08

MNP Content	Heating rate (℃ s^{-1})
5 wt. %	0.64
10 wt. %	1.53
15 wt. %	4.09


A
coil
L1
95℃
℃
110
100
90
80
70
60
50
40
30
B
L2
72℃
C
L3
55℃
D
Inside of chamber
L1
Avg: 95.9℃
L2
Avg.: 71.8℃
L3
Avg.: 54.5℃
Temperature (°C)
110
100
90
80
70
60
50
40
30
20


A)
Cycle No. 1
3 kA m-1
1.7 kA m-1
0 kA m-1
0.9 kA m-1
3 kA m-1
1.2 kA m-1
Set point 1
Set point 3
Set point 2
Temperature profile
Set point region
Temperature (°C)
Time (s)
B)
M
1
2
732 bp
C)
Relative band intensity (%)
MNP-PDMS chip
Conventional PCR thermocycler