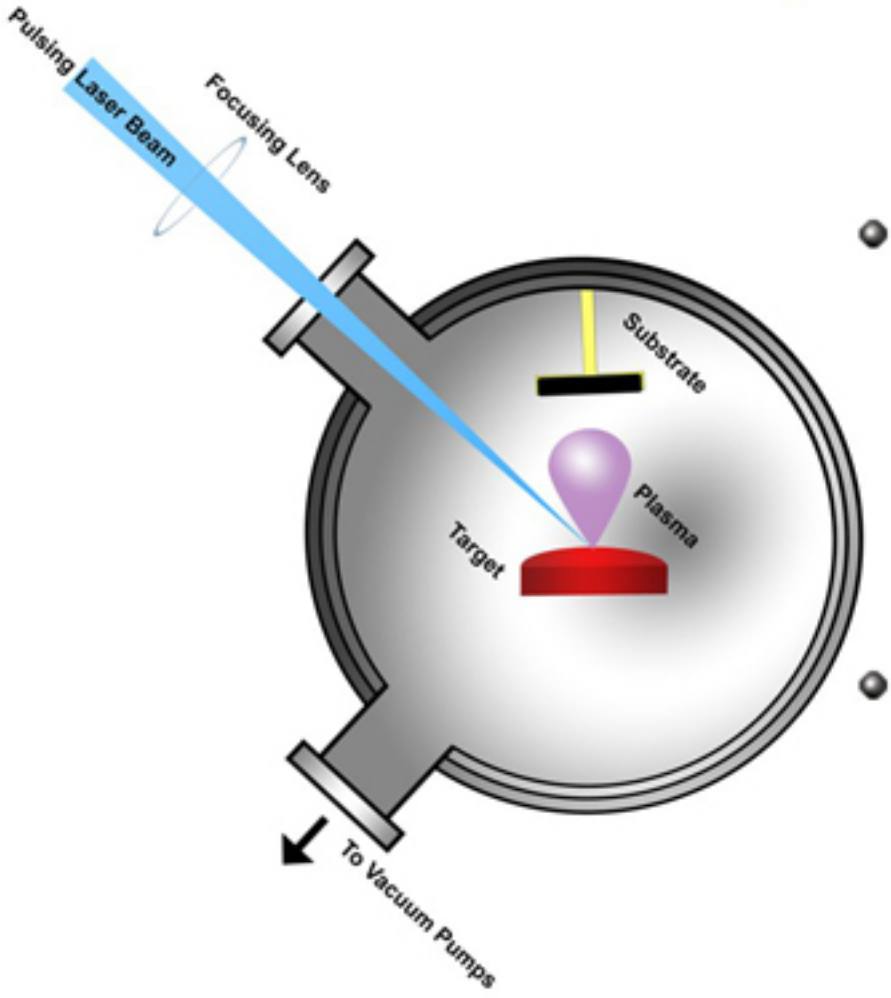
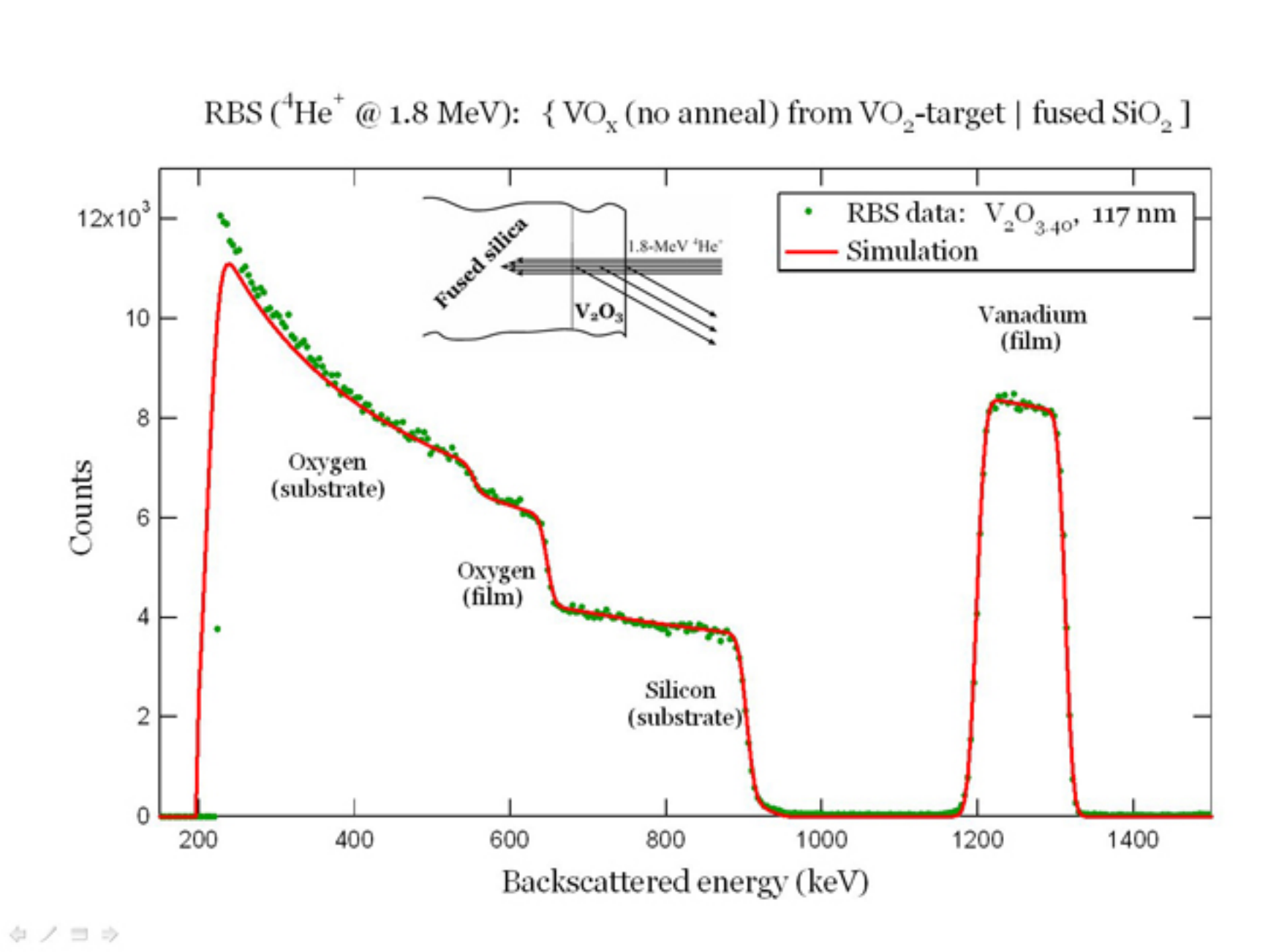
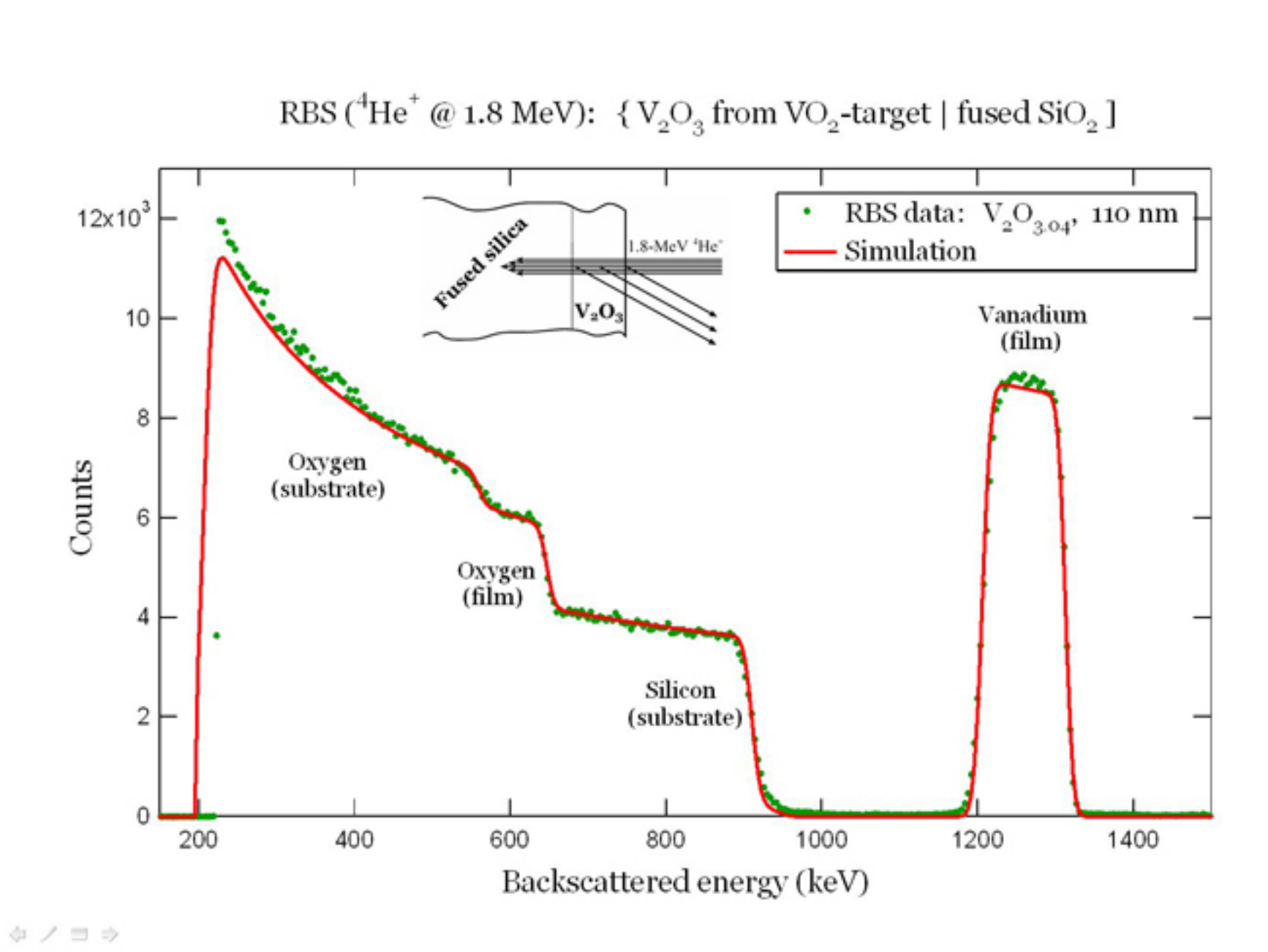
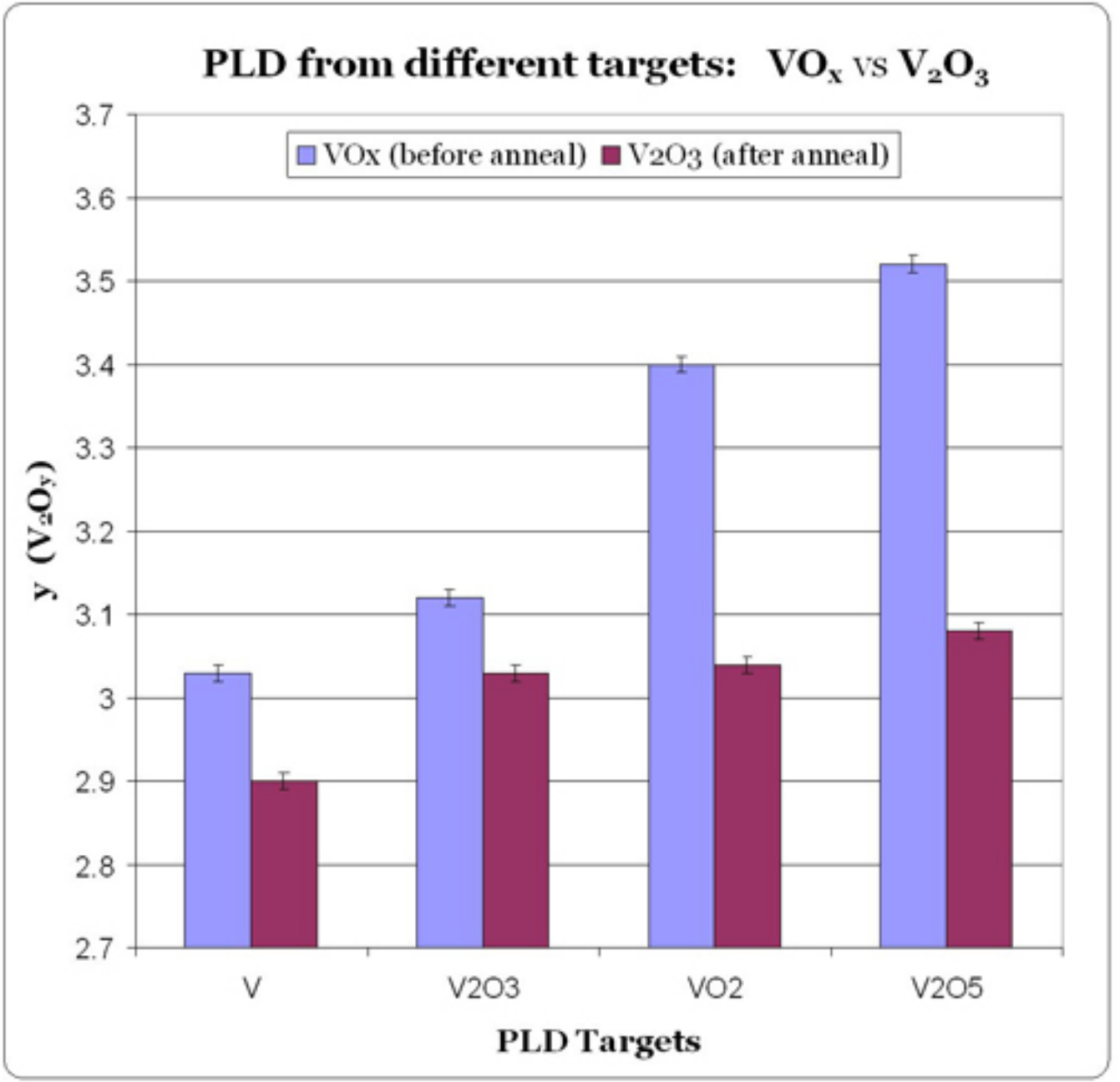
Pulsed-Laser Deposition (PLD) and Annealing of V_2O_3 Thin Films

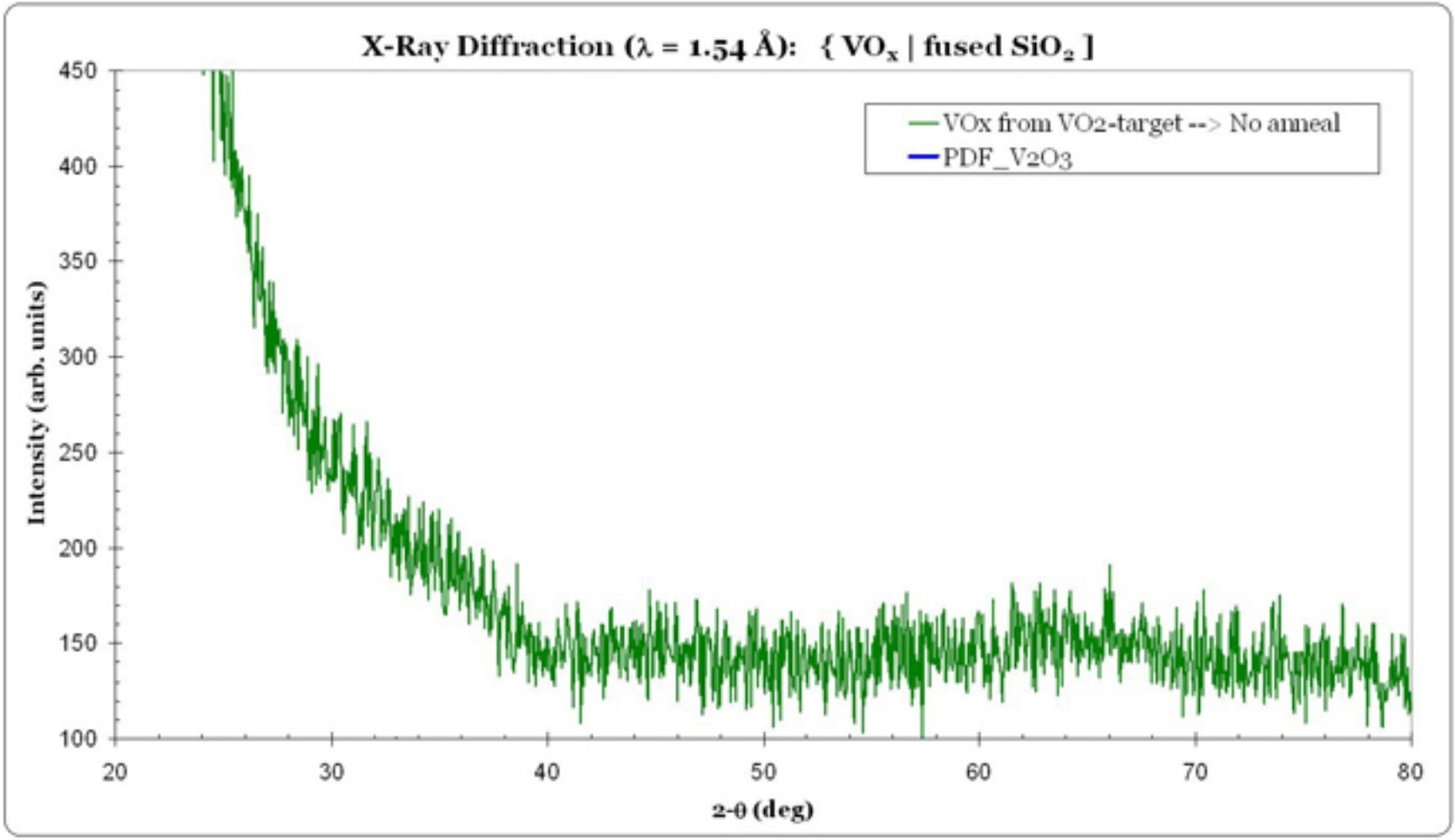


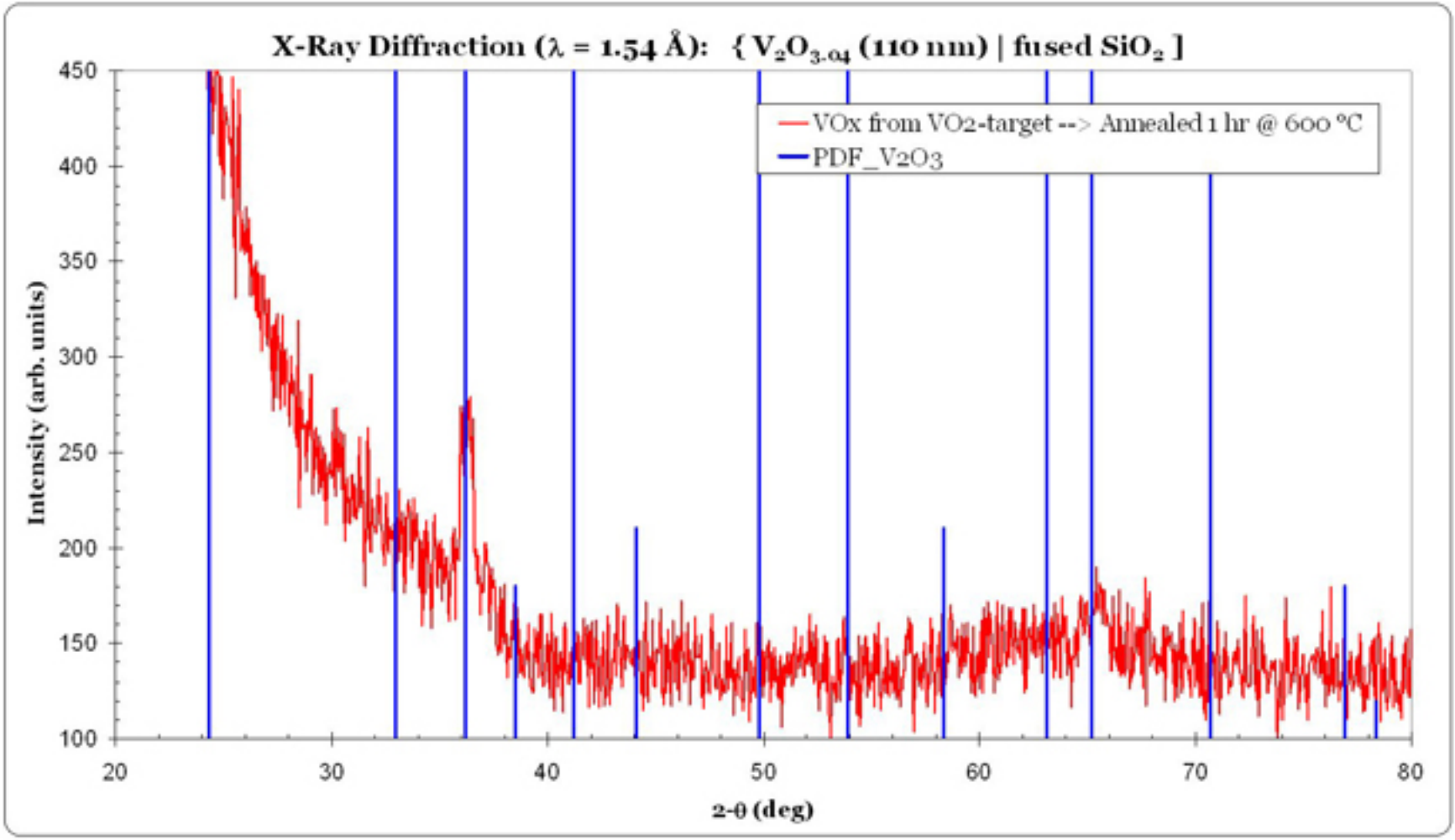
- Deposition → PLD chamber
  - Laser: KrF excimer (λ = 248 nm)
  - Targets: V_xO_y pressed powders
  - Substrates: Al_2O_3, SiO_2
  - Vacuum: ~10^{-6} Torr
  - Temperature: ambient
- Annealing → Tube furnace
  - Temperature: 600 °C
  - Gas: 1 atm. {Ar + 4% H_2}
  - Time: 1 hr

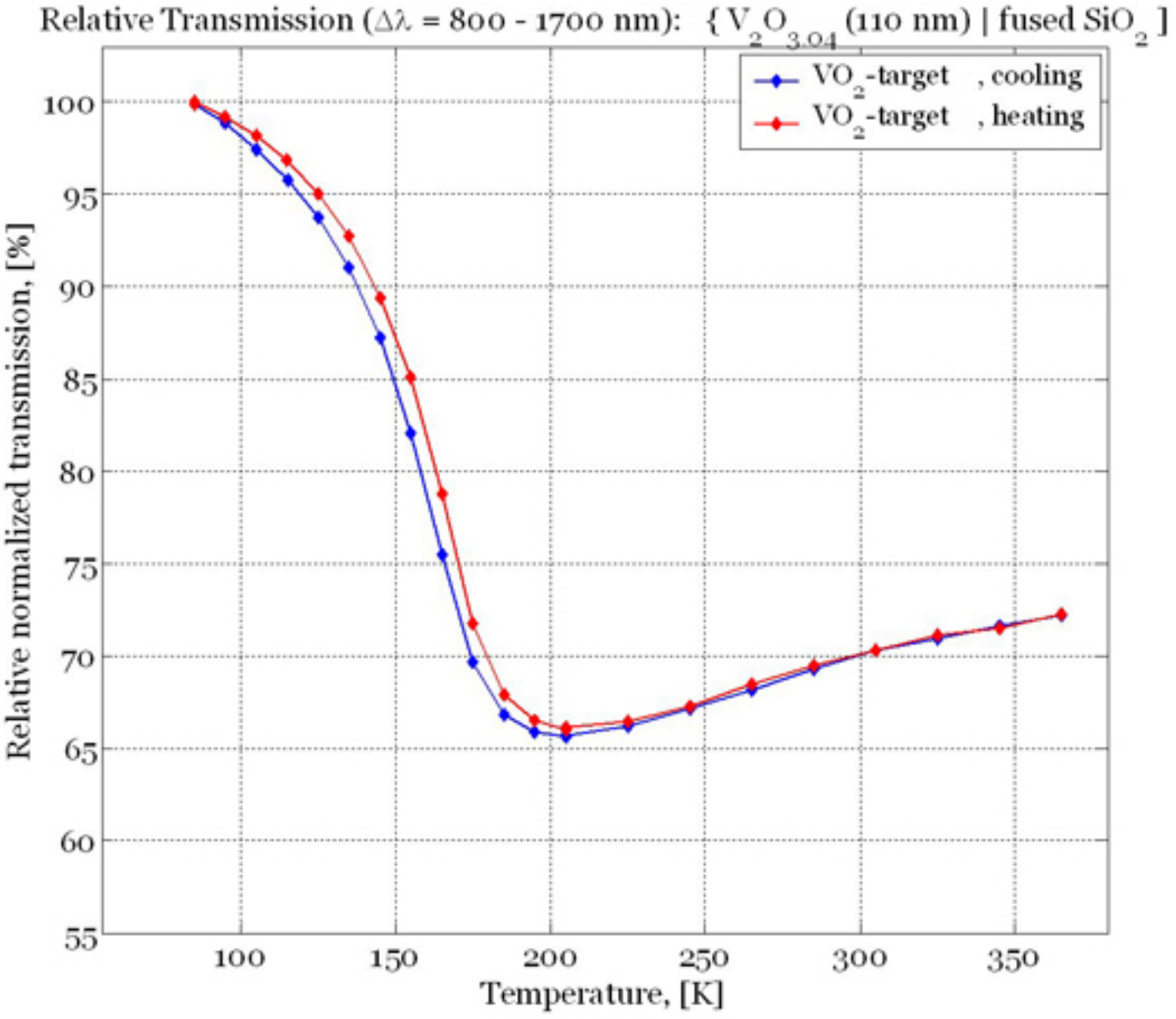

RBS ($^4He^+$ @ 1.8 MeV): { VO_x (no anneal) from VO_2-target | fused SiO_2 }
RBS data: $V_2O_{3.40}$, 117 nm
Simulation
Fused silica
1.8-MeV $^4He^+$
V_2O_3
Vanadium (film)
Oxygen (substrate)
Oxygen (film)
Silicon (substrate)
Counts
12x10^3
10
8
6
4
2
0
200
400
600
800
1000
1200
1400
Backscattered energy (keV)

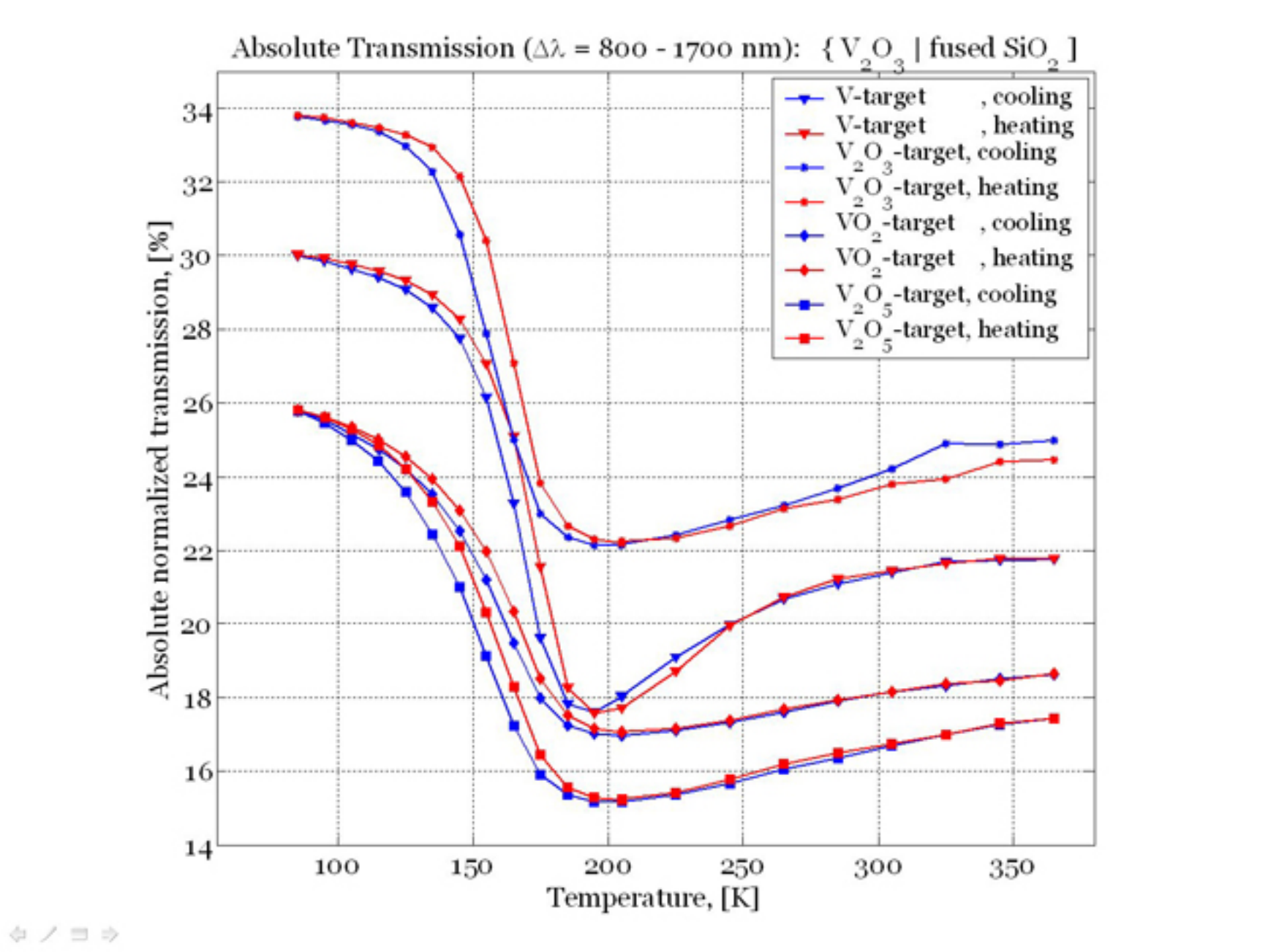

RBS ($^4He^+$ @ 1.8 MeV): { V_2O_3 from VO_2-target | fused SiO_2]
RBS data: $V_2O_{3.04}$, 110 nm
Simulation
Fused silica
1.8-MeV $^4He^+$
V_2O_3
Vanadium (film)
Oxygen (substrate)
Oxygen (film)
Silicon (substrate)
Counts
12x10^3
10
8
6
4
2
0
200
400
600
800
1000
1200
1400
Backscattered energy (keV)

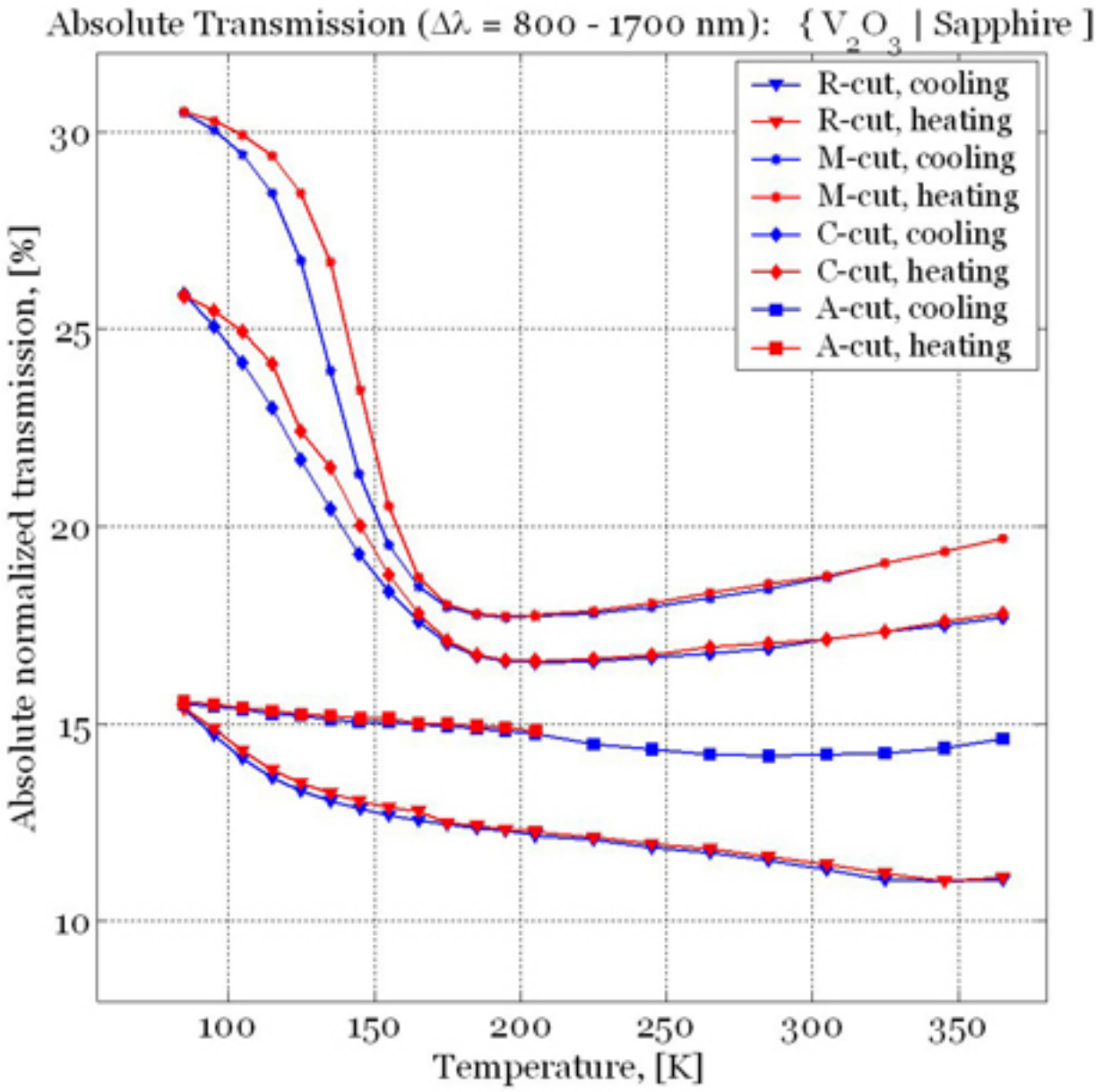

PLD from different targets: VOx vs V2O3
VOx (before anneal)
V2O3 (after anneal)
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
y (V2Oy)
V
V2O3
VO2
V2O5
PLD Targets


X-Ray Diffraction (λ = 1.54 Å): { VOx | fused SiO2]
VOx from VO2-target --> No anneal
PDF_V2O3
Intensity (arb. units)
2-θ (deg)
450
400
350
300
250
200
150
100
20
30
40
50
60
70
80


X-Ray Diffraction (λ = 1.54 Å): { $V_2O_{3.04}$ (110 nm) | fused SiO_2 }
VOx from VO2-target --> Annealed 1 hr @ 600 °C
PDF_V2O3
Intensity (arb. units)
2-θ (deg)
450
400
350
300
250
200
150
100
20
30
40
50
60
70
80


Relative Transmission (Δλ = 800 - 1700 nm): { V2O3.04 (110 nm) | fused SiO2]
VO2-target , cooling
VO2-target , heating
Relative normalized transmission, [%]
100
95
90
85
80
75
70
65
60
55
100
150
200
250
300
350
Temperature, [K]


Absolute Transmission (Δλ = 800 - 1700 nm): { V2O3 | fused SiO2 }
V-target , cooling
V-target , heating
V2O3-target, cooling
V2O3-target, heating
VO2-target , cooling
VO2-target , heating
V2O5-target, cooling
V2O5-target, heating
Absolute normalized transmission, [%]
Temperature, [K]
34
32
30
28
26
24
22
20
18
16
14
100
150
200
250
300
350


Absolute Transmission (Δλ = 800 - 1700 nm): { V2O3 | Sapphire]
R-cut, cooling
R-cut, heating
M-cut, cooling
M-cut, heating
C-cut, cooling
C-cut, heating
A-cut, cooling
A-cut, heating
Absolute normalized transmission, [%]
30
25
20
15
10
100
150
200
250
300
350
Temperature, [K]