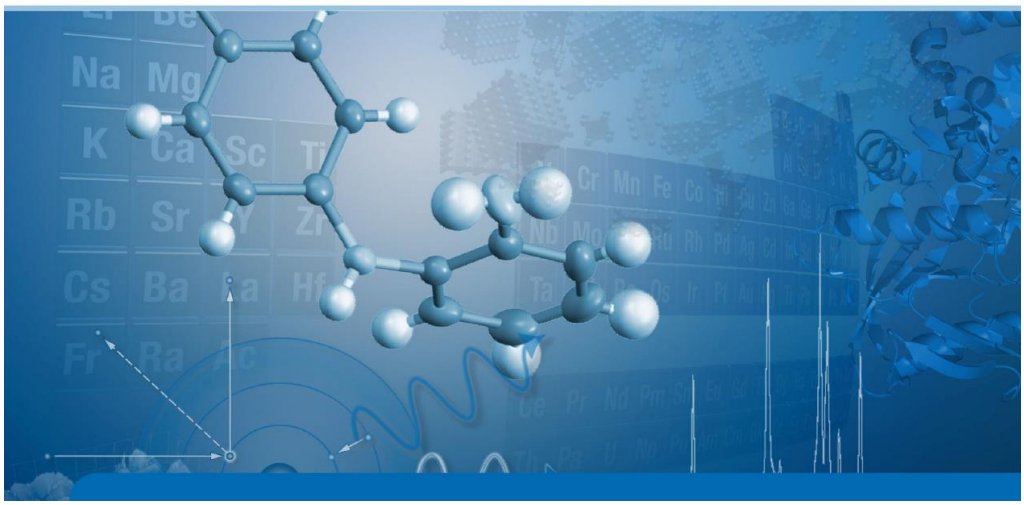
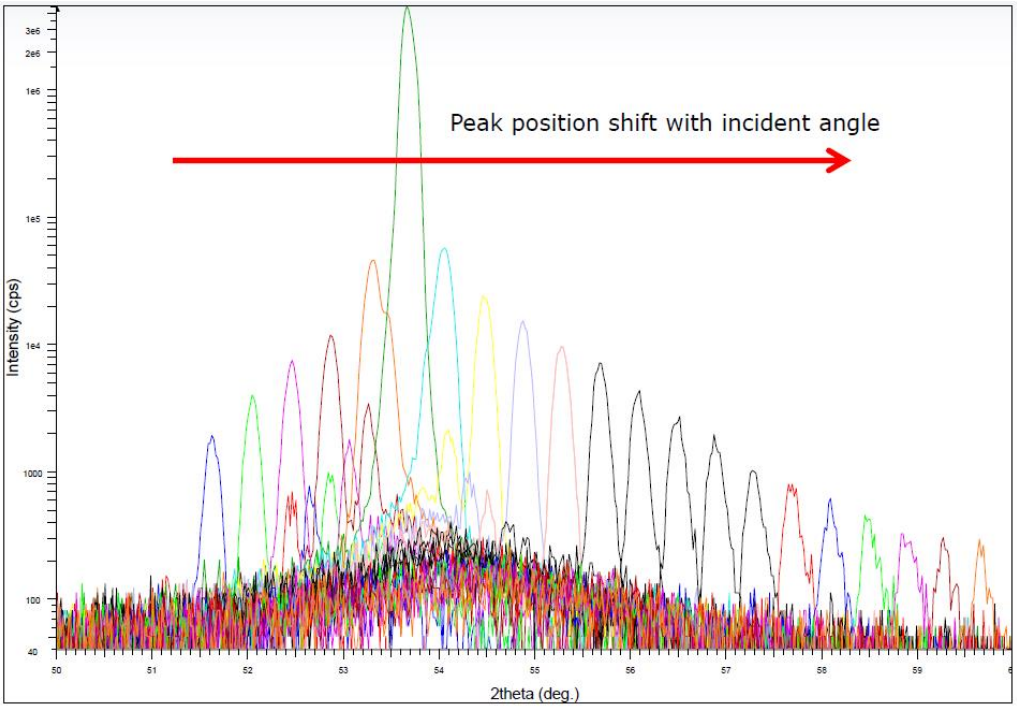
Supplementary Materials

Part 1: A brief report provided by Bruker Corporation for explaining "Why Si (113) peak appear in GIXRD profile?"

Why Si (113) Peak Appear in GID profile?

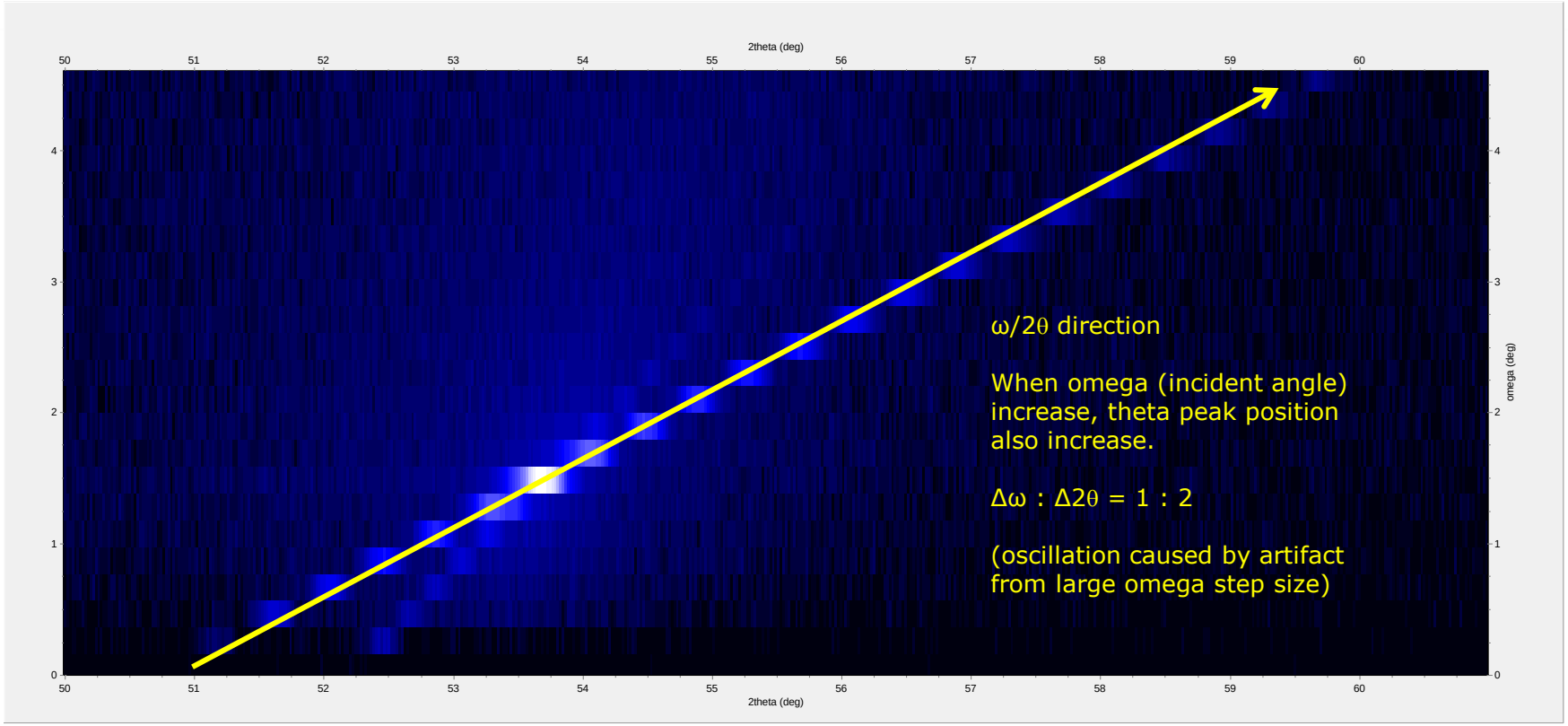


Ghost peak shift as incident angle change



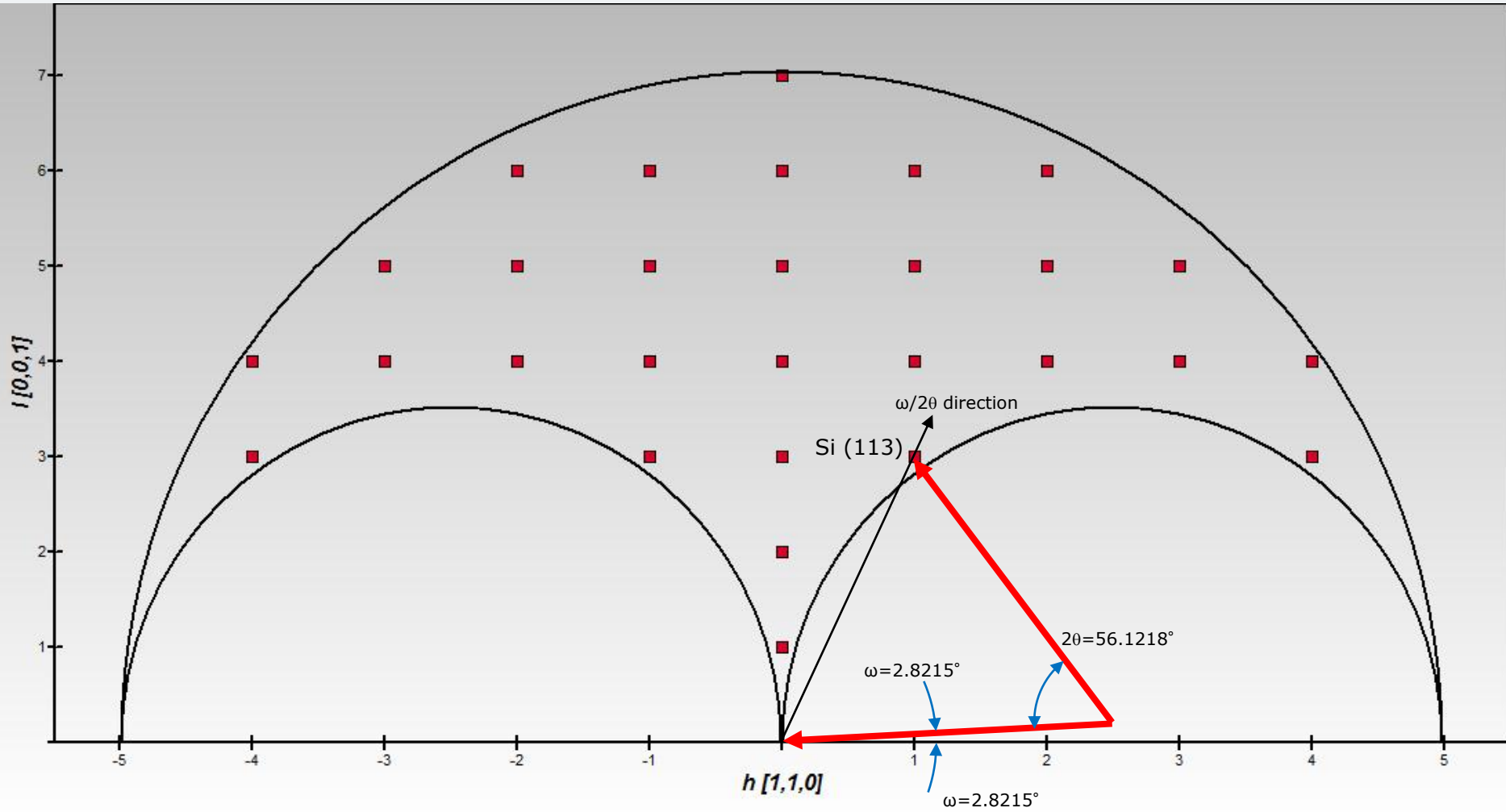
Si (113) diffraction in GI mode

Angular space plot



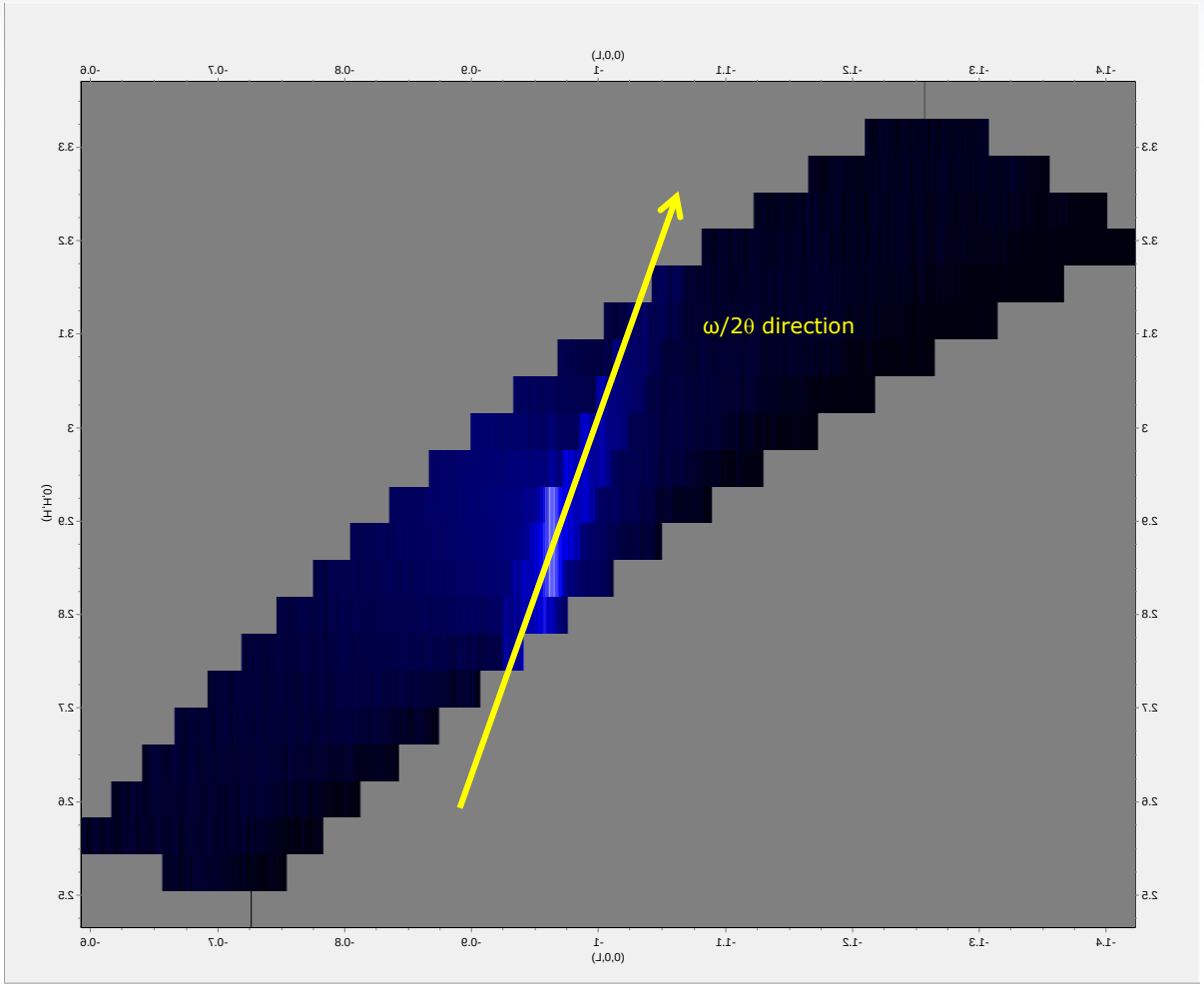
Si (113) diffraction in GI mode

Reciprocal Space Plot



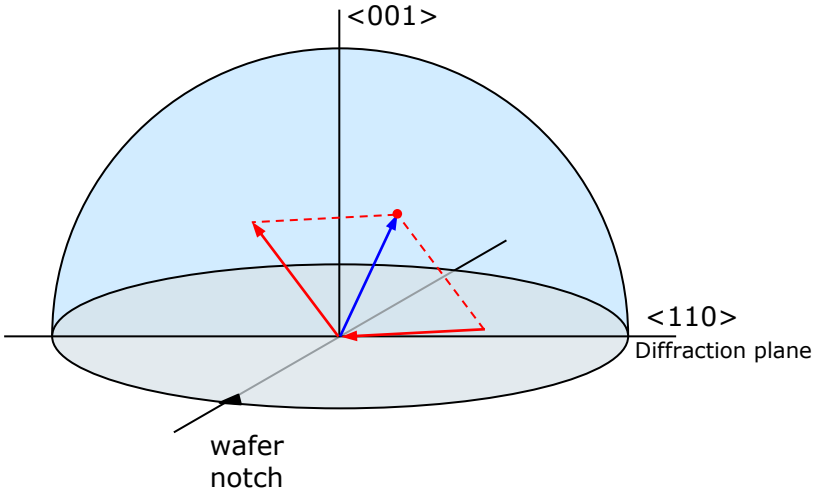
Si (113) diffraction in GI mode

Reciprocal Space Plot (converted from Angular Space Plot)

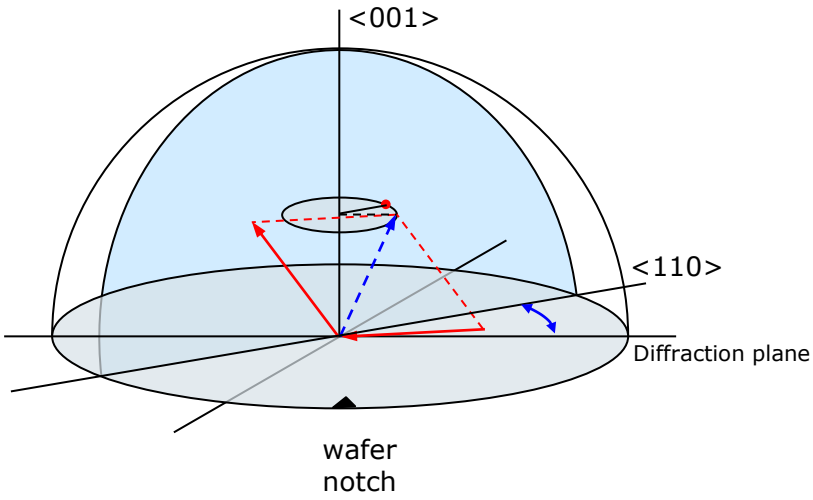


Avoid Si (113) diffraction by rotate Phi

- Phi = 0°
- Bragg condition is fulfilled.
- Si (113) appears at GID scan.

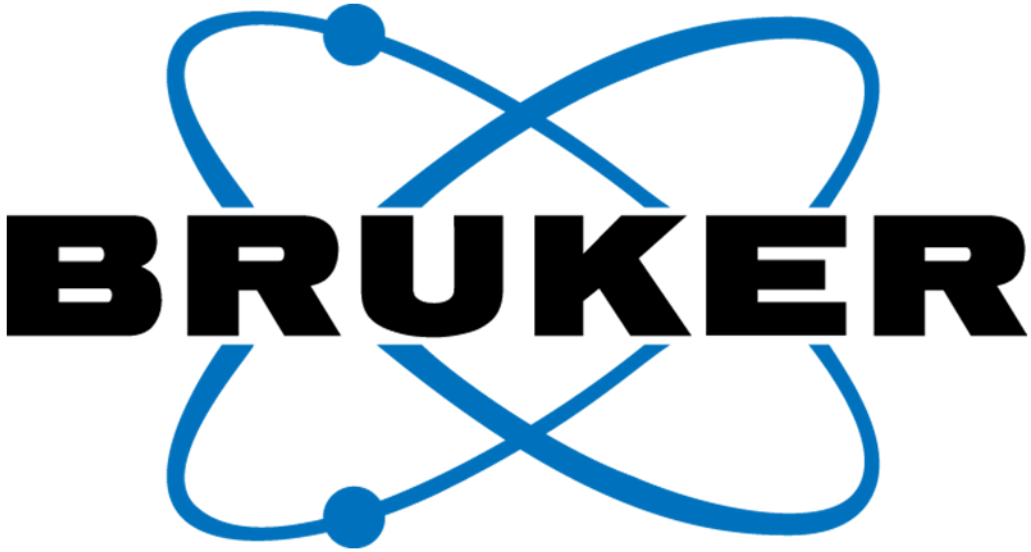


- Phi ≠ 0° (~10°)
- Bragg condition is not fulfilled.
- No Si (113) at GID scan.



Conclusion

- In GID measurements, Si (113) peak is easy to observe between 50 to 60 degree when Si (110) direction (notch direction) along or perpendicular the diffraction plane.
- Since the incident angle is not perfectly match with Si(113) Bragg angle, the peak observed in GID profile is not really the Si(113) peak but related to the dispersive diffuse scatterting due to relatively wide X-ray spectrum from X-ray source. In this case, the 2 theta peak position will not match with theoretical Si(113) Bragg angle.
- The dispersive diffuse scattering streak is along the omega-2theta direction. Therefore, when the incident angle (omega angle) in GID change, 2theta will shift by double of the offset amount.
- Because Si(113) is a strong diffraction peak from single crystal substrate, the tail of this diffuse streak will extend very far and still has significant intensity which can be easily observed in GID measurements.
- To avoid this phenomenon, the easiest solution is to rotate the sample by ~10 degree. In this case, Si (110) direction is not in diffraction plane any more. In this case, it is impossible to excite the Si(113) peak in GID.



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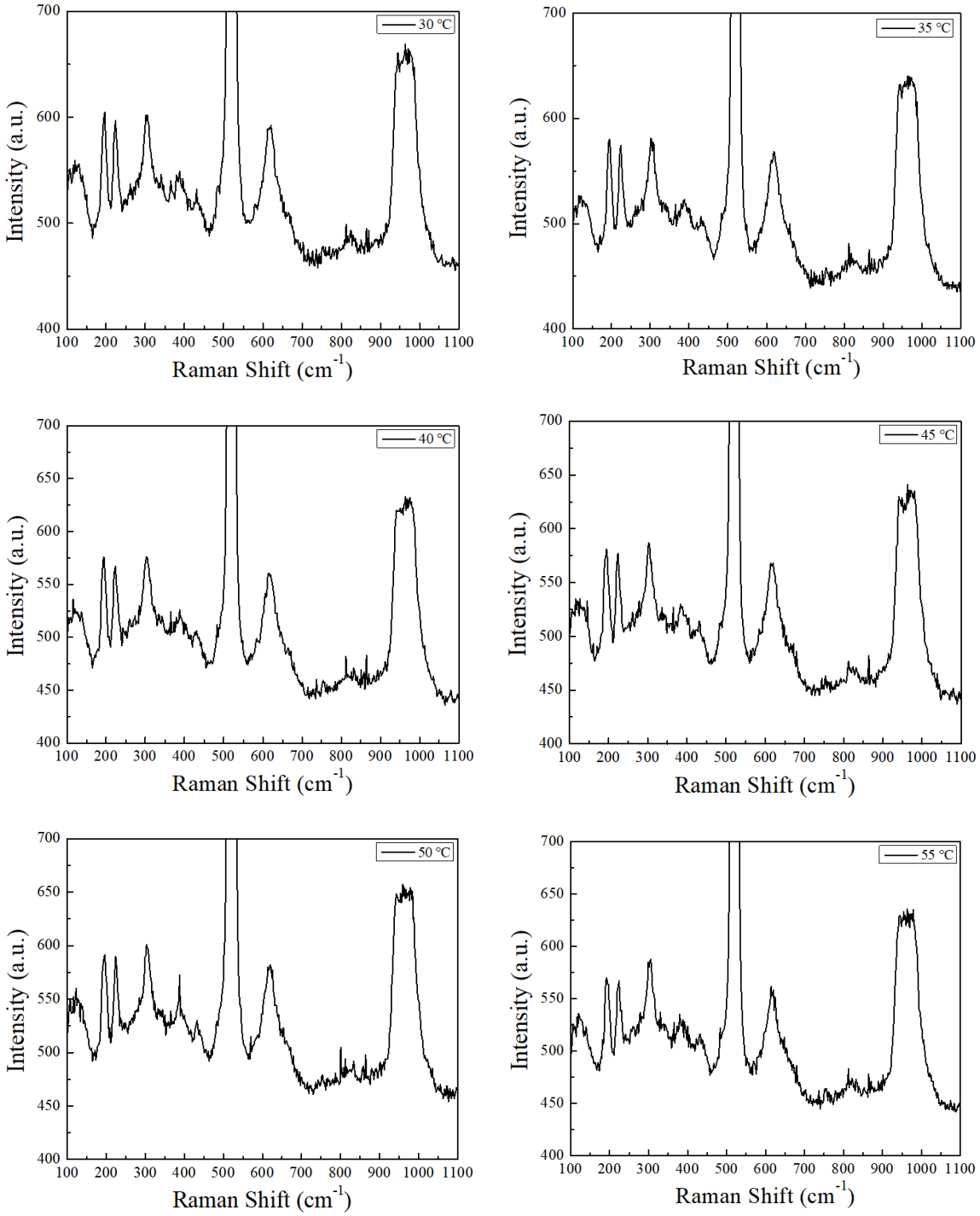
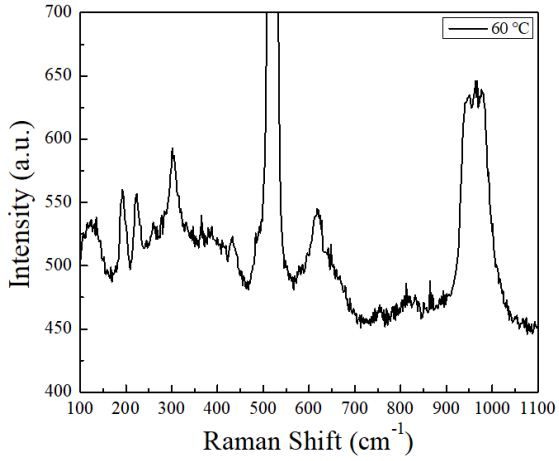
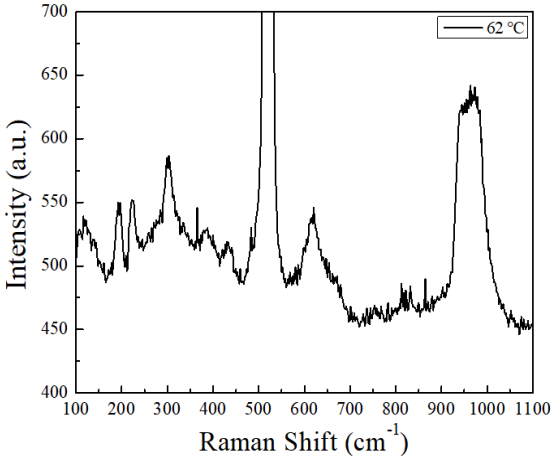
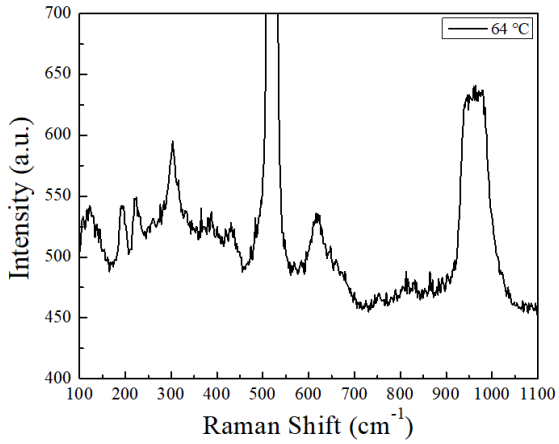
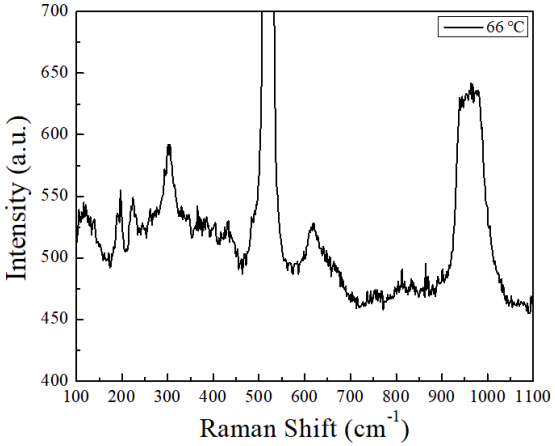
Part 2: Full temperature-dependent Raman spectra of the VO_2 films.

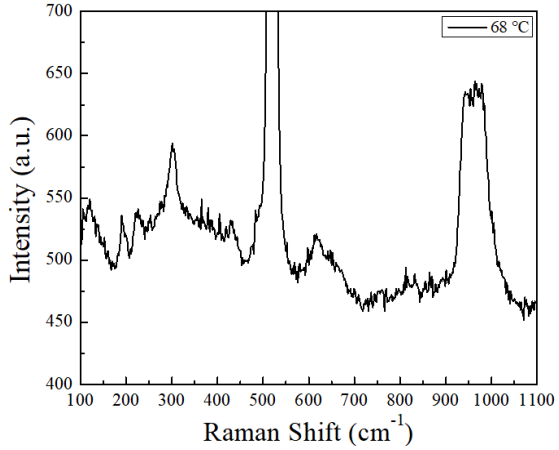


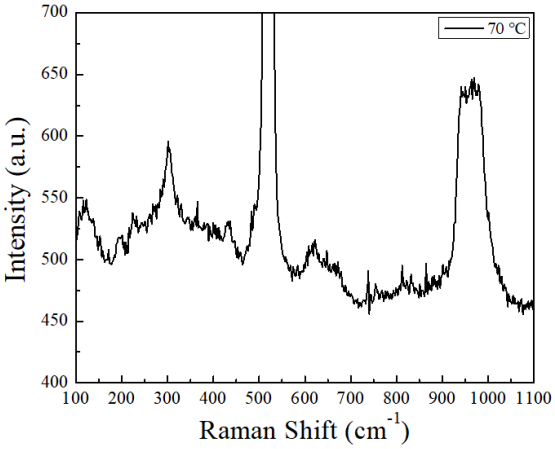

60 °C
Intensity (a.u.)
Raman Shift (cm-1)


62 °C
Intensity (a.u.)
Raman Shift (cm-1)


64 °C
Intensity (a.u.)
Raman Shift (cm-1)


66 °C
Intensity (a.u.)
Raman Shift (cm-1)


68 °C
Intensity (a.u.)
Raman Shift (cm-1)


70 °C
Intensity (a.u.)
Raman Shift (cm-1)

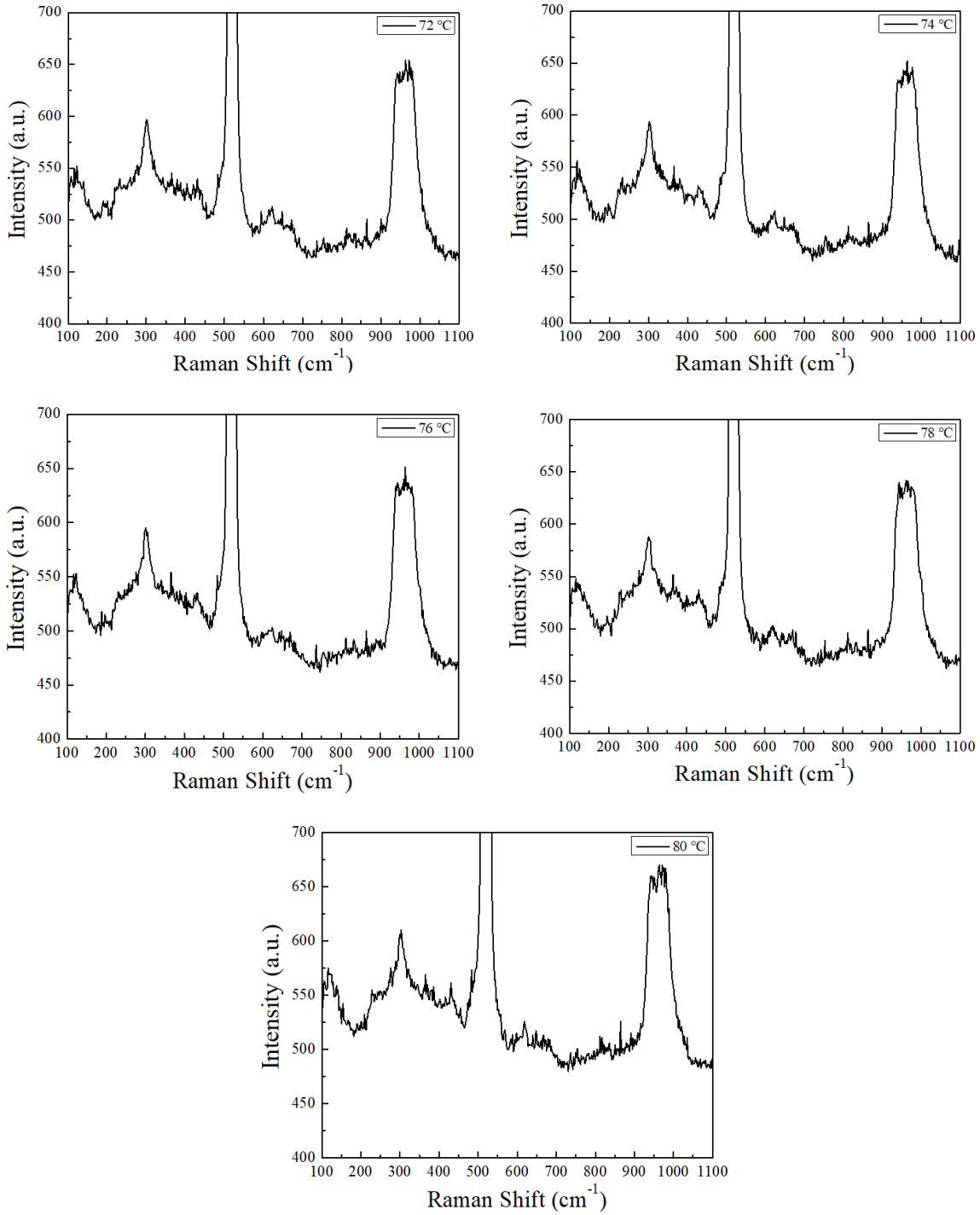
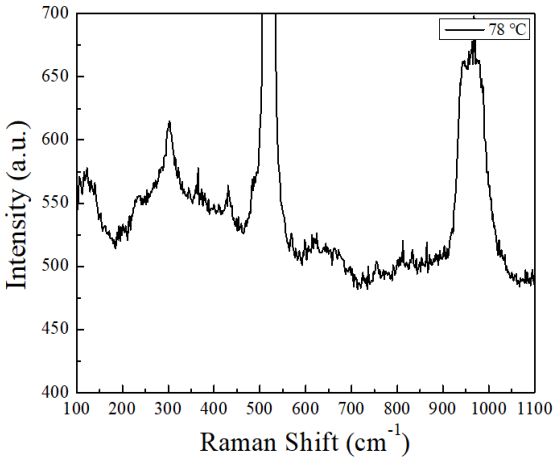
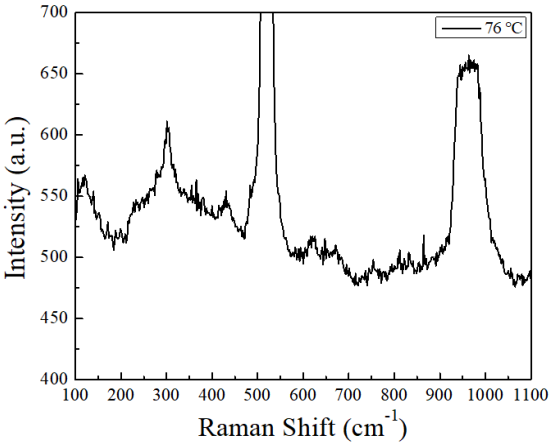
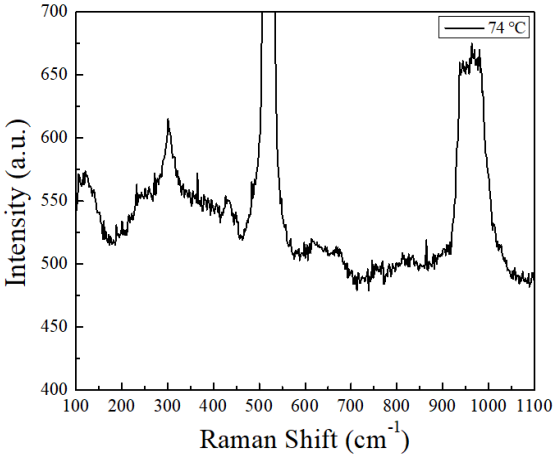
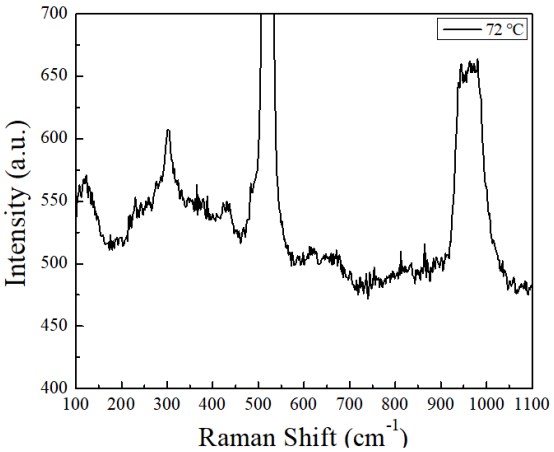


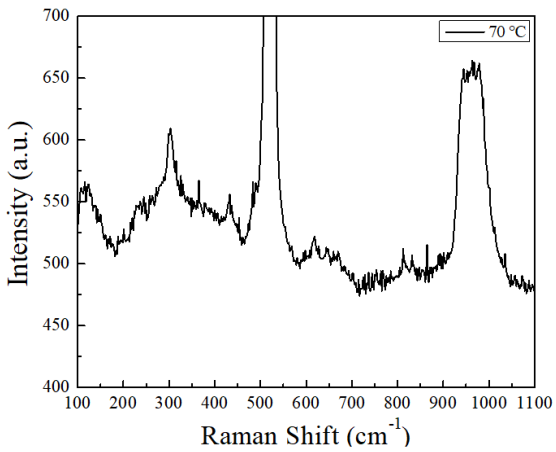
Figure S1. Raman spectra of the VO_2 film measured at indicant temperature for heating cycle (temperature from 30 to 80 °C).

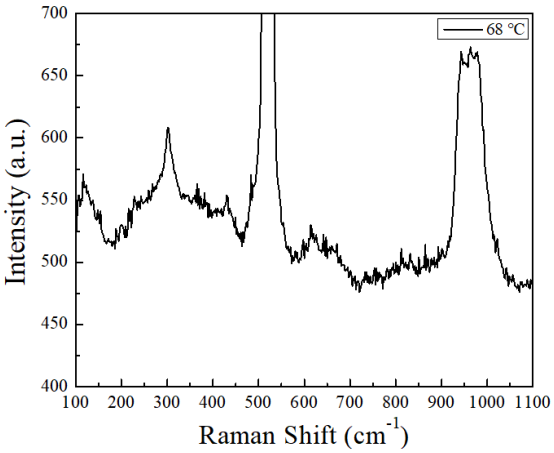

78 °C
Intensity (a.u.)
Raman Shift (cm-1)

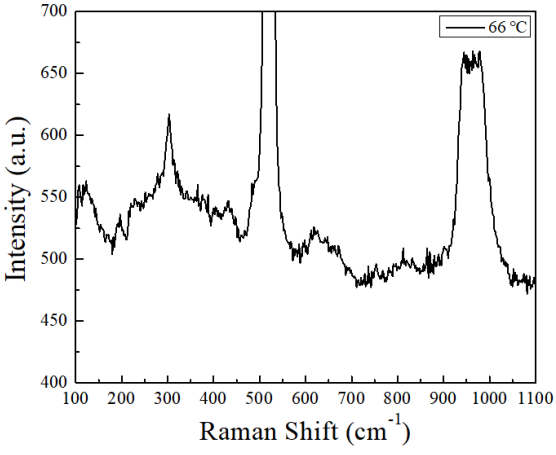

76 °C
Intensity (a.u.)
Raman Shift (cm-1)

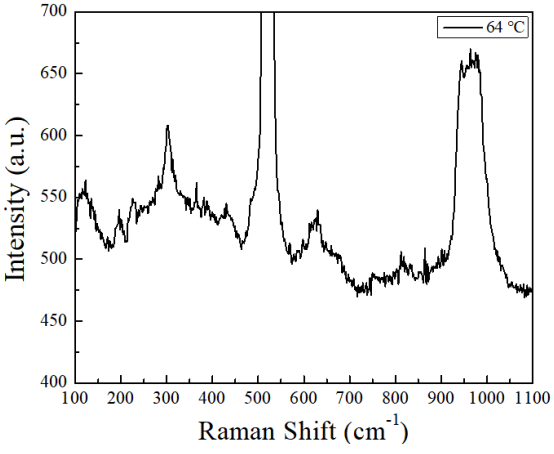

74 °C
Intensity (a.u.)
Raman Shift (cm-1)


72 °C
Intensity (a.u.)
Raman Shift (cm-1)


70 °C
Intensity (a.u.)
Raman Shift (cm-1)


68 °C
Intensity (a.u.)
Raman Shift (cm-1)


66 °C
Intensity (a.u.)
Raman Shift (cm-1)


64 °C
Intensity (a.u.)
Raman Shift (cm-1)

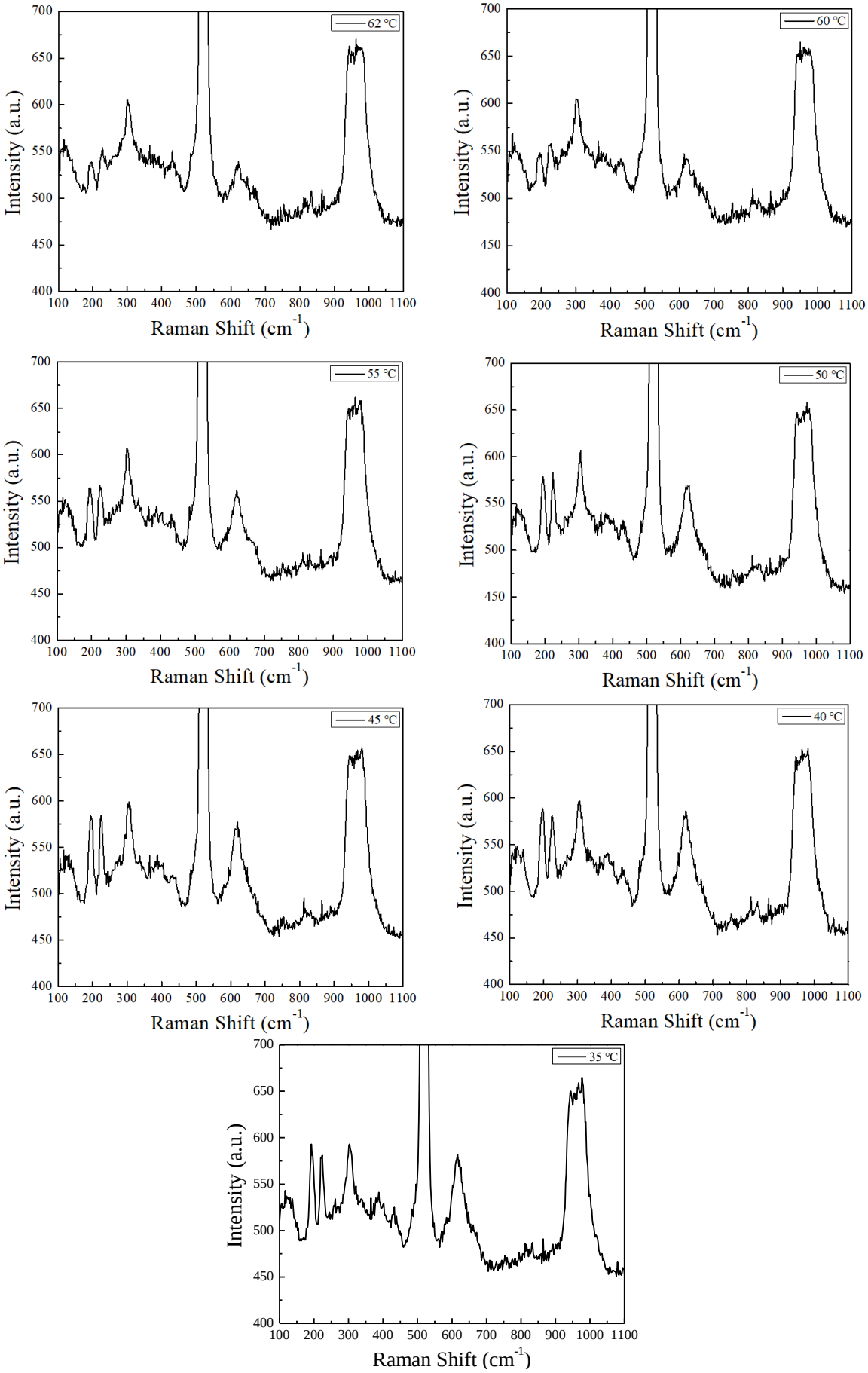


Figure S2. Raman spectra of the VO_2 film measured at indicant temperature for cooling cycle (temperature from 78 to 35 °C).