

Attn: Mr. Terence Li
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55 Tai Hong Street,
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Optical Characterization of V-KOOL Thin Films

Objective:

To measure the transmission/reflectance spectra of films and glass in the range of Ultra Violet (UV), Visible Light (Vis) and Infrared Radiation (IR).

Samples:

- ✓ V-KOOL VK 40, V-KOOL VK 70, V-KOOL VK 75 thin films;
- ✓ 4 mm Clear Glass;
- ✓ V-KOOL VK40, V-KOOL VK 70 and V-KOOL VK75 on 4mm Clear Glass;
- ✓ 6mm Laminated Glass;
- ✓ V-KOOL VK40, V-KOOL VK 70, V-KOOL VK75 on 6mm Laminated Glass;
- ✓ 6 mm Tinted Glass;
- ✓ V-KOOL VK 70 on 6mm Tinted Glass;
- ✓ FxK(II), SonCool 63 & SonCool 70 films;
- ✓ 6mm Reflected Glass;
- ✓ V-KOOL VK 70 on 6mm Reflected Glass;
- ✓ All samples are submitted for test by V-KOOL Consultant (HK) Ltd.

Measurement:

UV-Vis spectra (190-1100 nm) were measured with Perkin Elmer Lambda 20 spectrometer. IR spectra (900-3000 nm) was measured with Bio-Rad FTS 6000 Fourier Transform Infrared Spectrometer. The IR reflectance was measured with UMA500 IR microscopy which is attached to the Bio-Rad FTS 6000. IR is in normal incidence for reflectance measurement.

Result:

Fig.1 - Fig.7 show the measured spectra for the samples mentioned above. The vibration in some spectra is due to the multi-reflection in the multilayered samples. Some of the IR spectra were calibrated based on the UV-Vis spectra in the overlapped region (900-1100 nm).

- Fig.1 UV-Vis-IR transmittance spectra for V-KOOL thin films.
- Fig.2 UV-Vis-IR transmittance spectra for V-KOOL thin films on 4 mm Clear Glass.
- Fig.3 UV-Vis-IR transmittance spectra for V-KOOL thin films on 6 mm Laminated Glass.
- Fig.4 UV-Vis-IR transmittance spectra for V-KOOL VK 70 film on 6 mm Tinted Glass.
- Fig.5 UV-Vis-IR transmittance spectra for different thin films.
- Fig.6 IR reflectance spectra for different thin films.
- Fig.7 UV-Vis-IR transmittance spectra for V-KOOL VK films on 6mm Reflected Glass.

By Dr. Borong SHI
Materials Characterization & Preparation Facility,
The Hong Kong University of Science & Technology

Discussion:

1) Fig.1 UV-Vis-IR transmittance spectra for V-KOOL thin films.

- a) V-KOOL VK 40:
The maximum Visible Light Transmittance occurs at approximately 650 nm. The intensity is 48%. The transmittance intensity gradually decreases at the range of NIR to FIR
- b) V-KOOL VK 70:
The maximum Visible Light Transmittance occurs at approximately 650 nm. The intensity is 73.2%. The transmittance intensity gradually reduced at the range of NIR to FIR
- c) V-KOOL VK 75:
The maximum Visible Light Transmittance occurs at approximately 650 nm. The intensity is 77%. The transmittance intensity gradually reduced at the range of NIR to FIR

The vibration in some spectra is due to the multi-reflection in the multi-layered samples.

2) Fig.2 UV-Vis-IR transmittance spectra for V-KOOL thin films on 4 mm Clear Glass.

- a) 4 mm Clear Glass only:
The maximum Visible Light Transmittance occurs at approximately 650nm. The intensity is 85%. The transmittance intensity from NIR to FIR is approximately 80%.
- b) V-KOOL films + 4mm Clear Glass:
The spectra for V-KOOL films + 4 mm clear glass are similar in shape to that in Fig.1.
UV – The films have significantly improved the UV rejection ability of the glass.
Vis - The films have slightly reduced. The Vis Transmittances are ranged from 45% to 76% depending on the type of films.
IR – The films have significantly improved the IR rejection ability of the glass.

3) Fig.3 UV-Vis-IR transmittance spectra for V-KOOL thin films on 6 mm Laminated Glass.

- a) 6 mm Laminated Glass:
The peak at the range of visible light spectrum is sharpened when compared to that in Fig.2 since the laminated layer between the glass blocked the visible light at the range of 650 – 800 nm. The transmittance intensity from NIR to FIR is approximately 65%.
- b) V-KOOL films + 6 mm Laminated Glass:
The spectra for V-KOOL films + 6 mm laminated glass are similar in shape to that in Fig.1 and Fig.2.
UV – The films have significantly improved the UV rejection ability of the glass.
Vis - The films have slightly reduced. The Vis Transmittances are ranged from 48% to 78% depending on the type of films.
IR – The films have significantly improved the IR rejection ability of the glass.

4) Fig.4 UV-Vis-IR transmittance spectra for V-KOOL VK 70 on 6 mm Tinted Glass.

a) 6 mm Tinted Glass:

The maximum Visible Light Transmittance occurs at approximately 650nm, the intensity is 68%, and the intensity is lower in compare with the clear glass. The color blocks the Vis intensity.

The transmittance intensity from NIR to FIR is approximately 65%.

b) V-KOOL film VK 70 + 6 mm Tinted Glass:

The spectra for V-KOOL film + 6mm Tinted Glass is similar in shape to that in Fig.1 and Fig.2.

UV – The film has significantly improved the UV rejection ability of the glass.

Vis - The film has slightly reduced the Vis Transmittance to approximately 52%.

IR – The film has significantly improved the IR rejection ability of the glass.

5) Fig.5 UV-Vis-IR transmittance spectra for different thin films.

a) V-KOOL VK 70:

Similar to that in the previous spectra in Fig.1

b) FxK (II):

The transmittance at the range of Vis is approximately 77%. The lowest NIR transmittance intensity is 45% at 1000 nm. However, the transmittance intensity rapidly rose to 80% at wavelength with 2000 nm and above, which was even higher than that of Tinted Glass and Laminated Glass at the same range (compared to Fig.3 & Fig.4).

c) SonCool 63 & SonCool 70:

The maximum Vis transmittance occurs at 650 nm with the intensities of 58% and 60% respectively.

NIR - The NIR transmittance intensities are 35% & 45%, which were higher than that of V-KOOL VK70 film.

FIR - The FIR transmittance intensities are similar to V-KOOL's VK70.

6) Fig.6 IR reflectance spectra for different thin films.

a) V-KOOL VK 70:

IR reflectance is over 85%

b) FxK (II):

IR reflectance is less than 15%

c) SonCool 63 & SonCool 70:

IR reflectance is less than 20%

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7) Fig.7 UV-Vis-IR transmittance spectra for V-KOOL VK 70 on 6 mm Reflected Glass.

c) 6 mm Reflected Glass:

The maximum Visible Light Transmittance occurs at approximately 650nm, the intensity is 23%, and the intensity is lower in compare with the clear glass. The coating reflects the Vis intensity.

The transmittance intensity from NIR to FIR is approximately 63%.

d) V-KOOL film VK 70 + 6 mm Reflected Glass:

The spectra for V-KOOL film + 6mm Reflected Glass is similar in shape to that in Fig.1 and Fig.2.

UV – The film has significantly improved the UV rejection ability of the glass.

Vis - The film has slightly reduced the Vis Transmittance to approximately 15%.

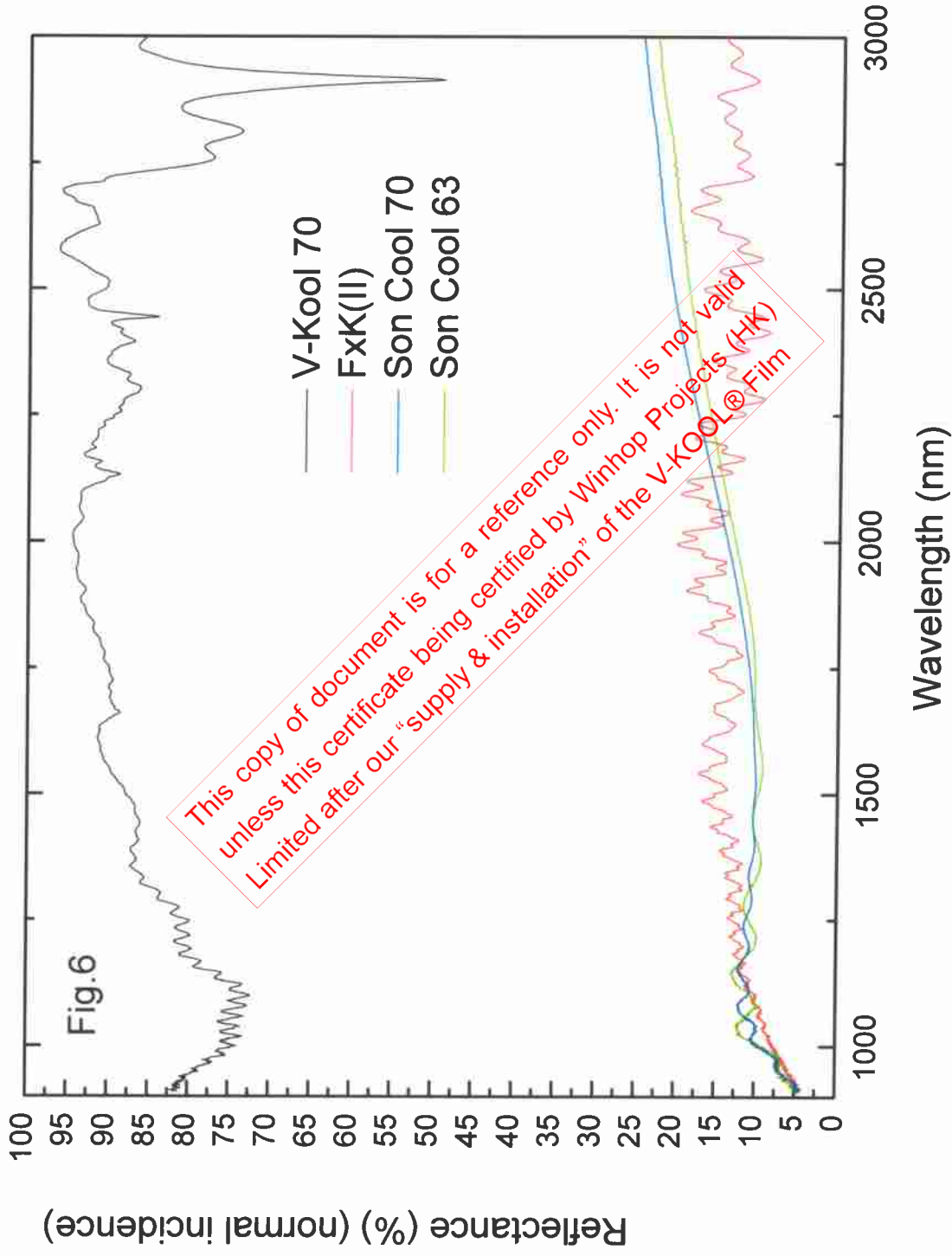
IR – The film has significantly improved the IR rejection ability of the glass.

Conclusion:

1. FxK (II) film is an IR Transmitting film.
2. SonCool films are IR Absorbent film.
3. V-KOOL films are IR Reflecting film. The IR rejection ability is the best among the tested films, Clear, Laminated, Tinted and Reflected Glass. Besides, V-KOOL film can significantly improve the IR rejection ability of the tested Glass after V-KOOL films are applied on the surfaces.

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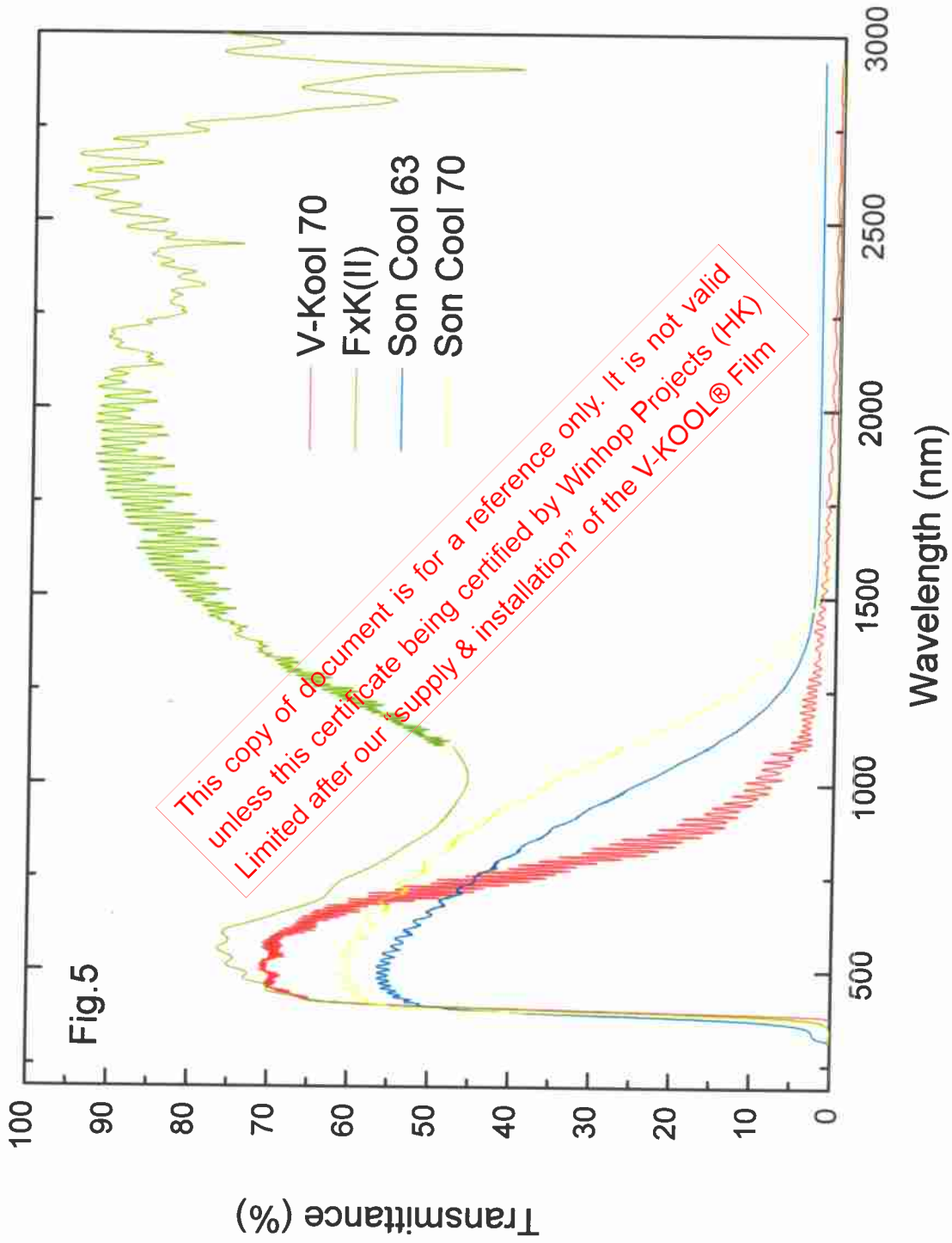
IR Reflectance Spectra



Notes:

1. Samples were provided by V-Kool Consultant (HK) LTD.
2. IR spectra (900-3000 nm) were measured with Bio-Rad FTS 6000 Fourier Transform Infrared Spectrometer.
3. The reflectance was measured with UMA500 IR microscopy which is attached to FTS6000. Au film surface as 100% reflection reference.
4. All measurements were performed at Materials Characterisation & Preparation Facility, The Hong Kong University of Science and Technology

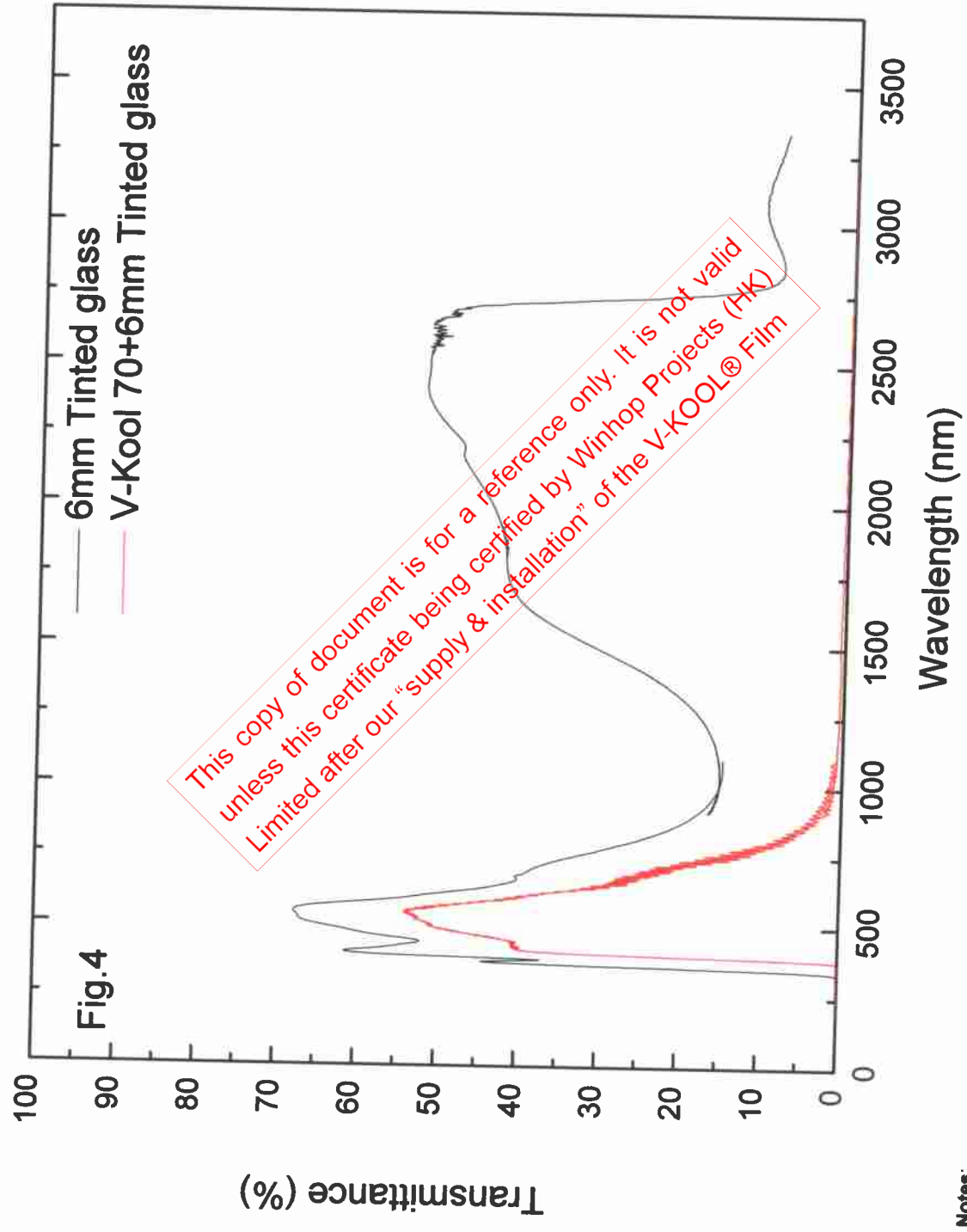
UV-Vis-IR Transmittance Spectra



Notes:

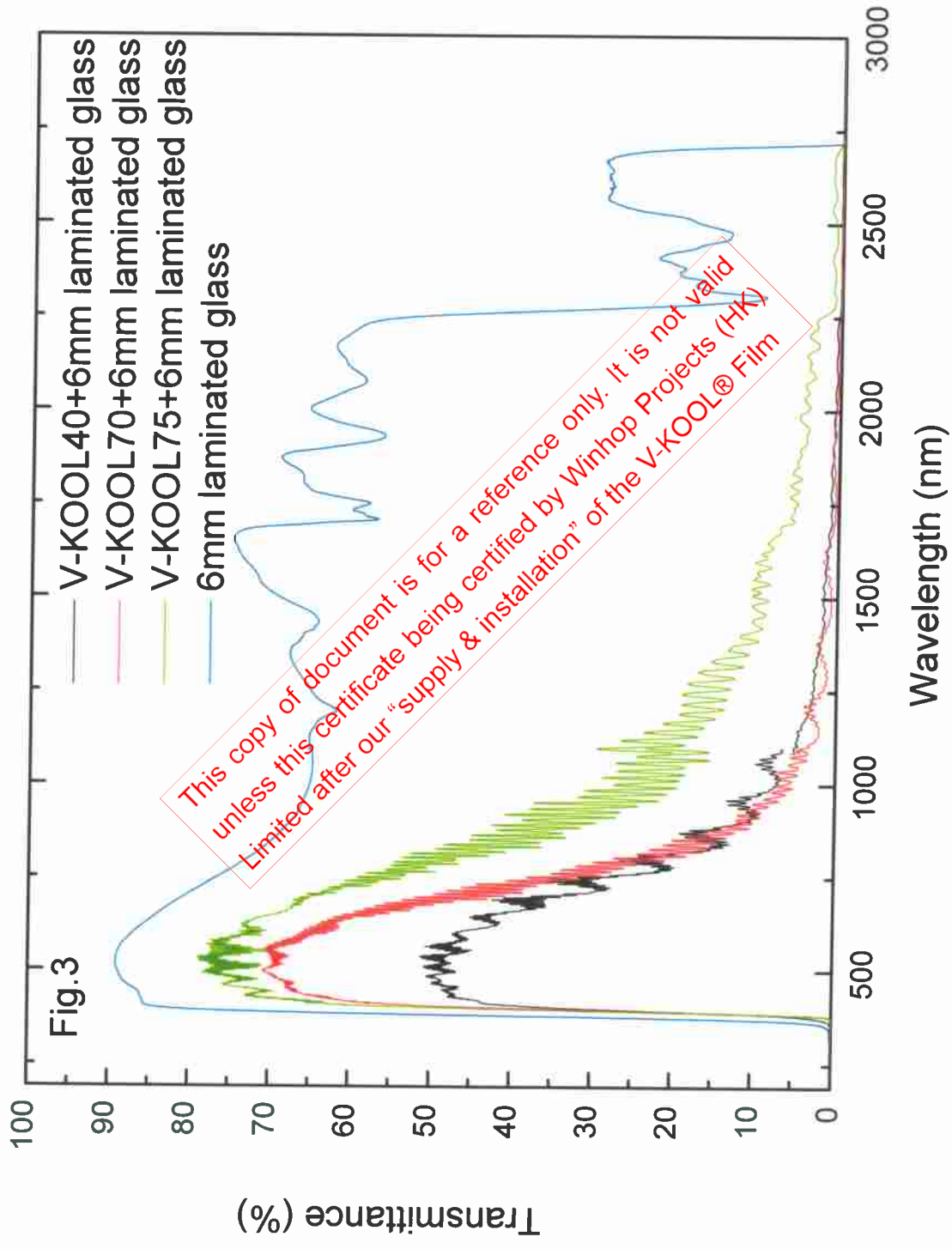
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UV-Vis-IR Transmittance Spectra



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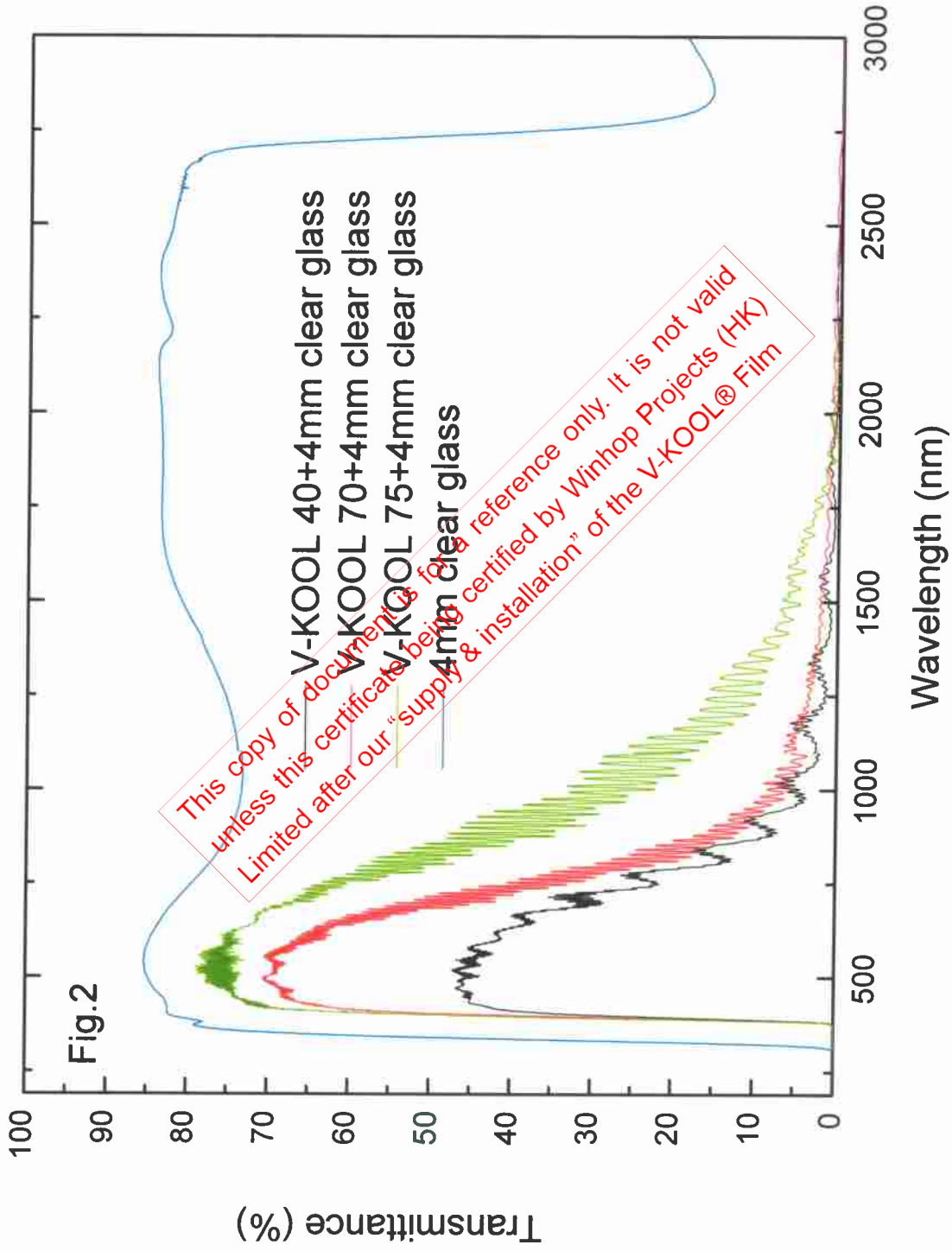
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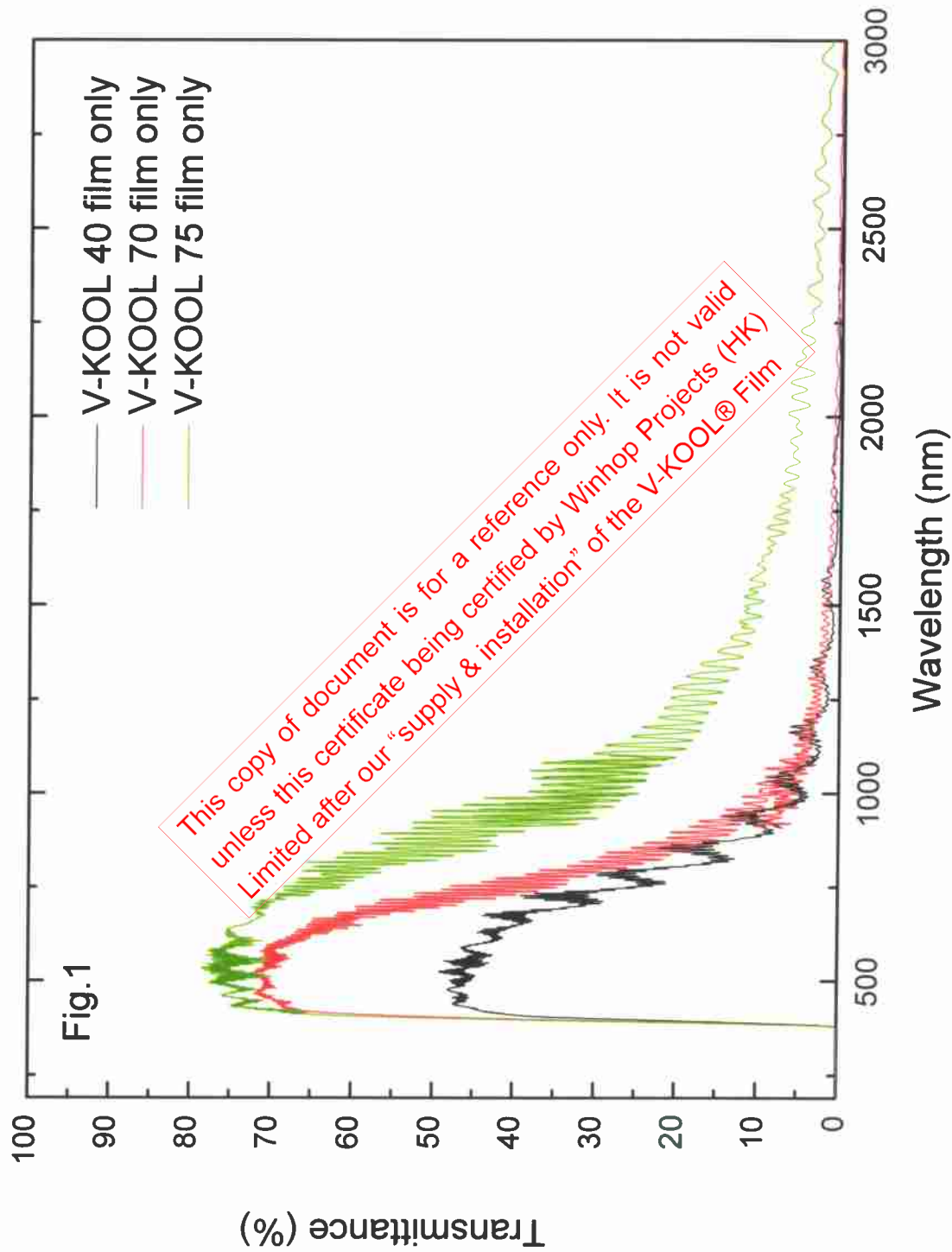
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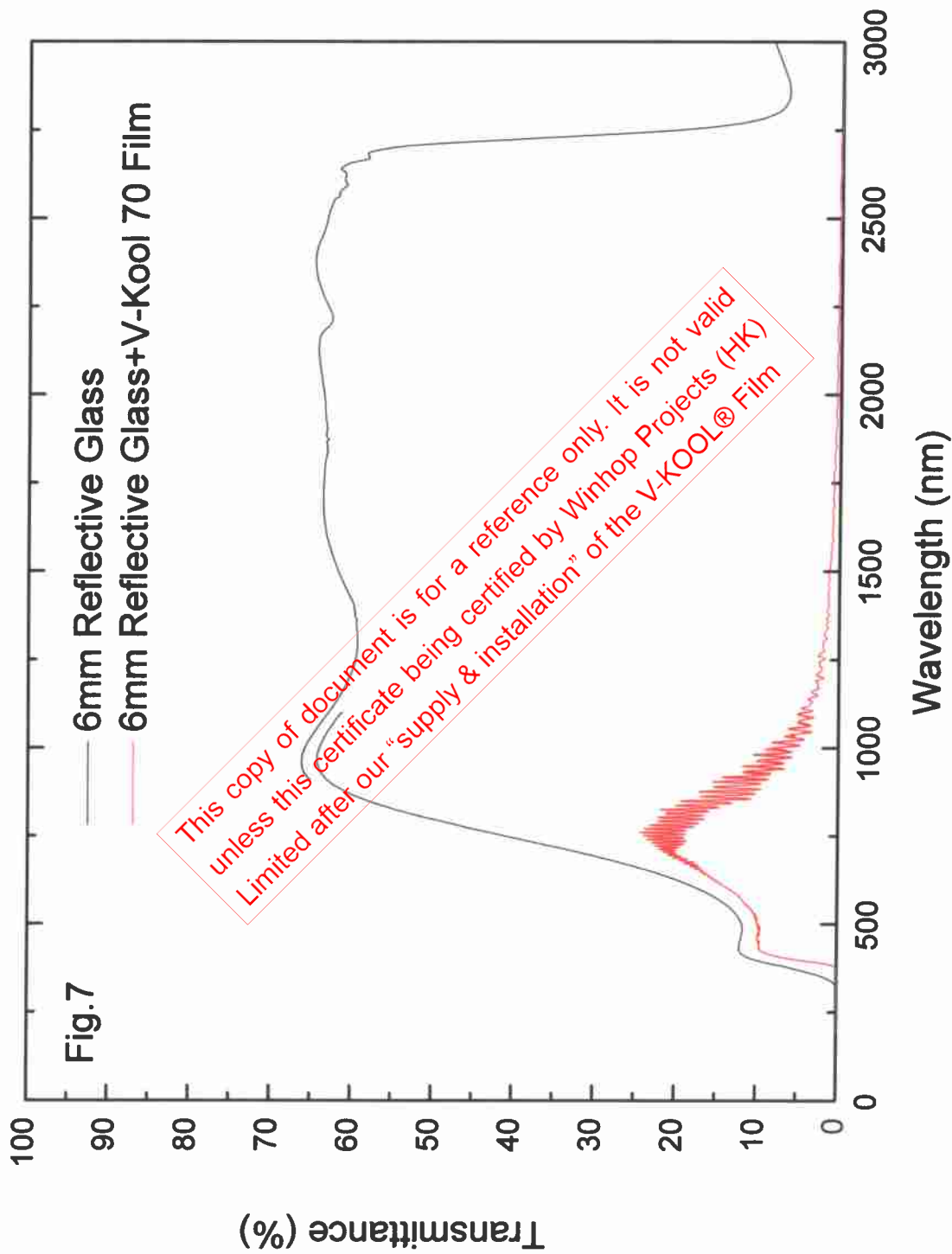
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UV-Vis-IR Transmittance Spectra



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