Effects of Endspoiling Variations on Microchannel Plate Performance

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Introduction:

- Microchannel Plates Are Solid State Electron Multipliers Consisting Of Millions Of Microscopic Single Channel Electron Multipliers Fused Together Into A Coherent Array
- Initially Developed For Use In The Night Vision Industry, Microchannel Plates Are Now Used As Detectors In Such Widely Varying Applications Ranging From Analytical Instrumentation Such As Secondary Ion Mass Spectrometers (SIMS), Residual Gas Analyzers (RGA), Scanning Electron Microscopes (SEM), VUV And Time Of Flight Mass Spectrometers, To The Recently Deployed Threat Warning Systems.

Typical Microchannel Plate Configurations

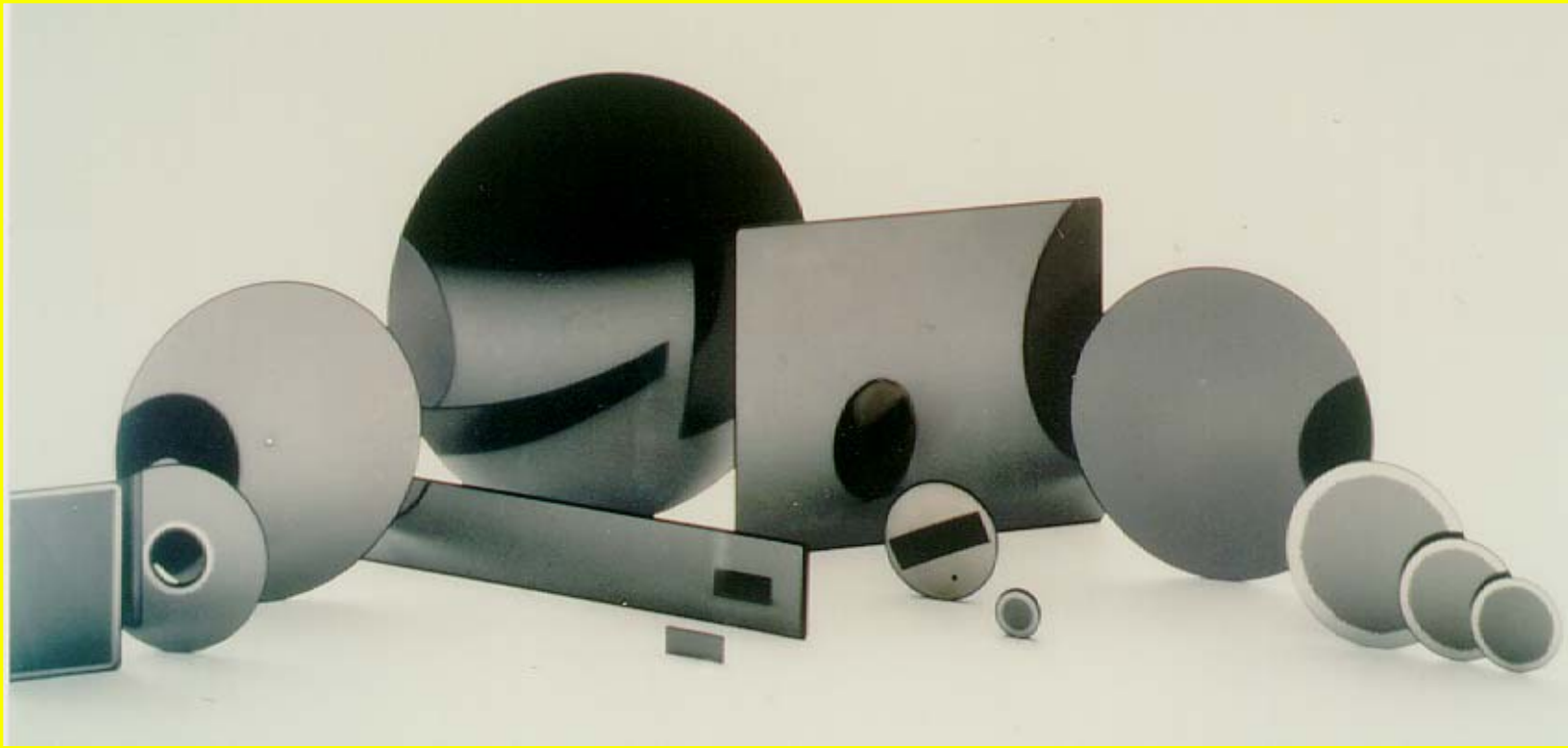

Figure 1

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The Operation Of A Microchannel Plate

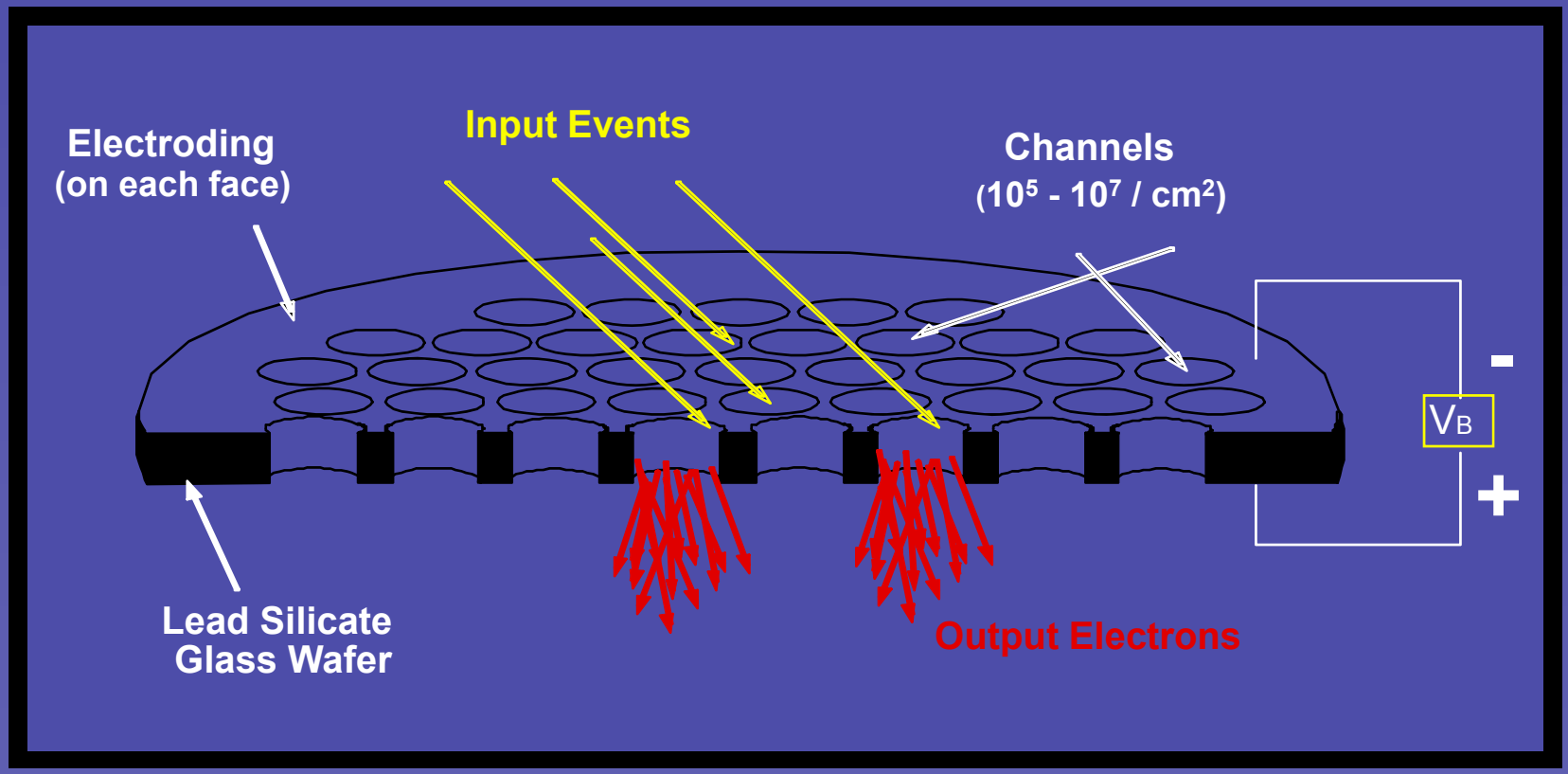

Figure 2

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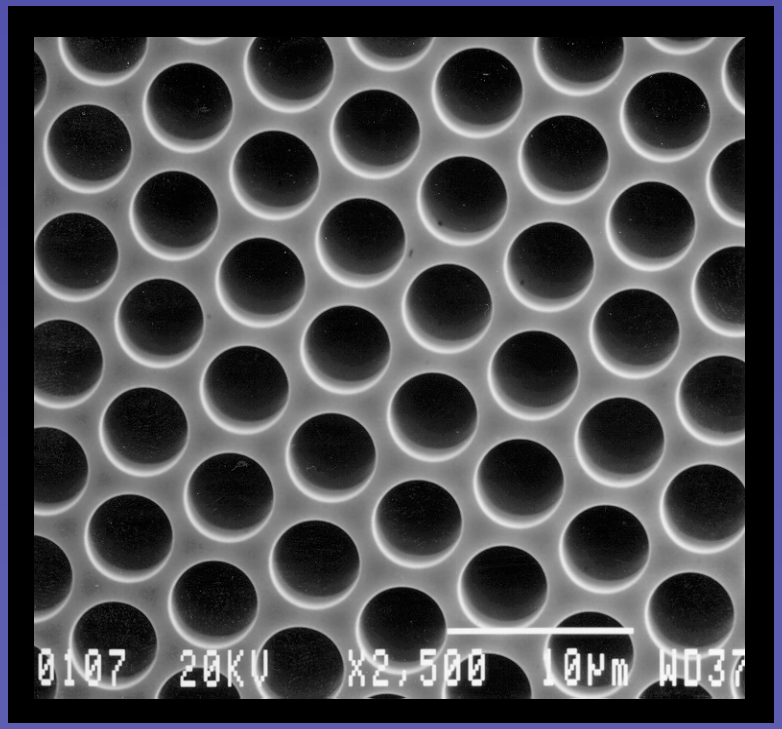
Objective:

- To Characterize The Relationship Between Microchannel Plate Endspoiling And Various MCP Performance Parameters.

Electrode Penetration

5 Micron and 25 Micron Pore Microchannels



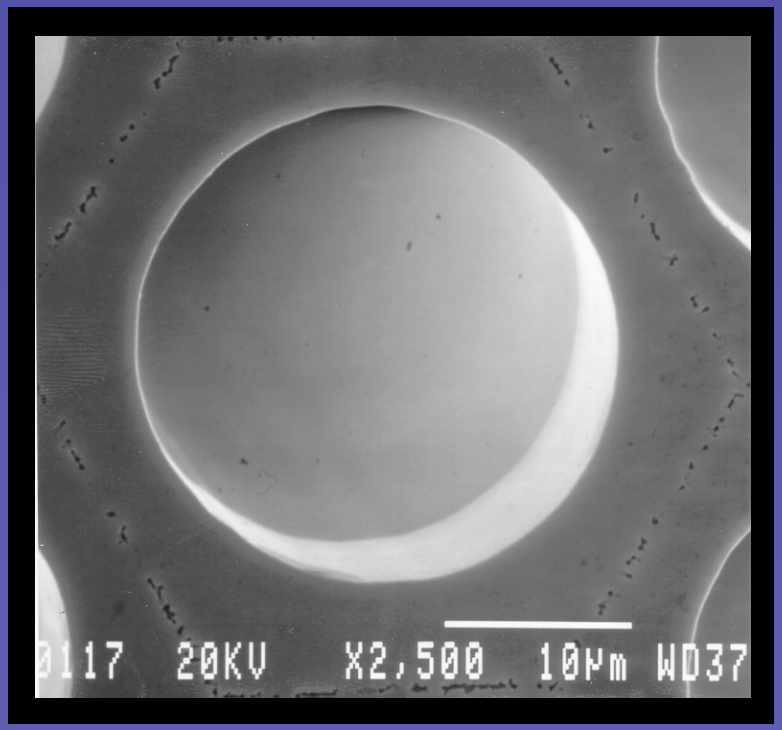


Figure 3

EXPERIMENTAL METHOD:

The Depth of Output Electrode Endspoiling Was Varied By Changes In Evaporation Angle

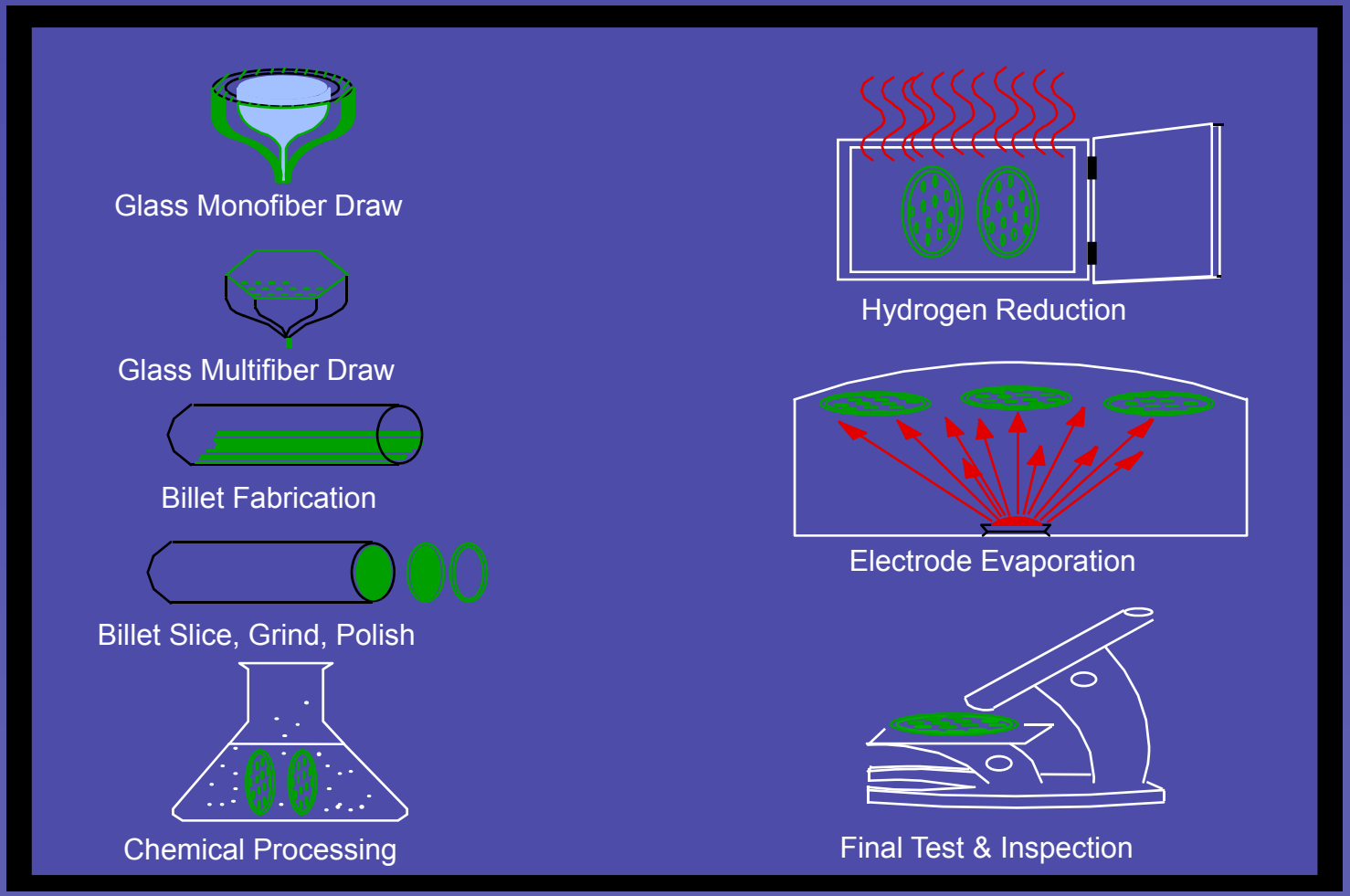


Figure 4

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Typical Input Side Endspoiling

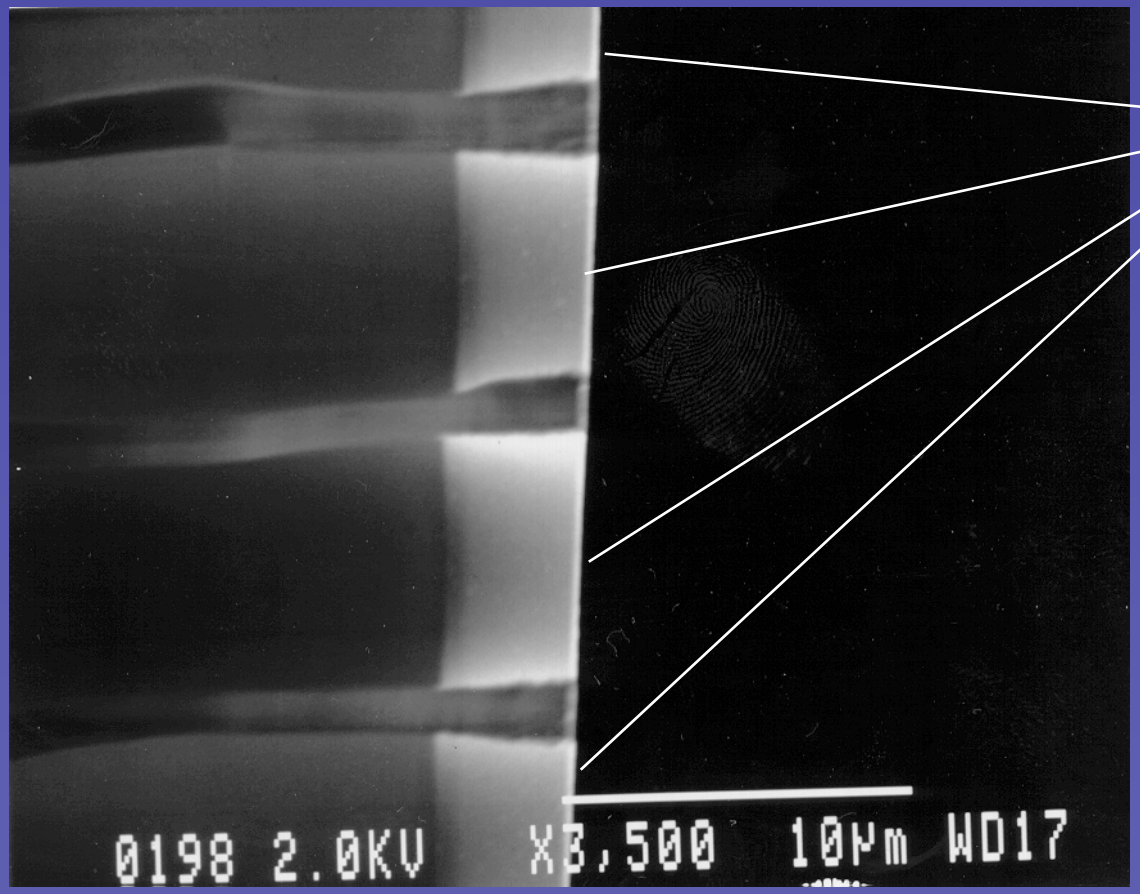

Figure 5

Typical Output Side Endspoiling

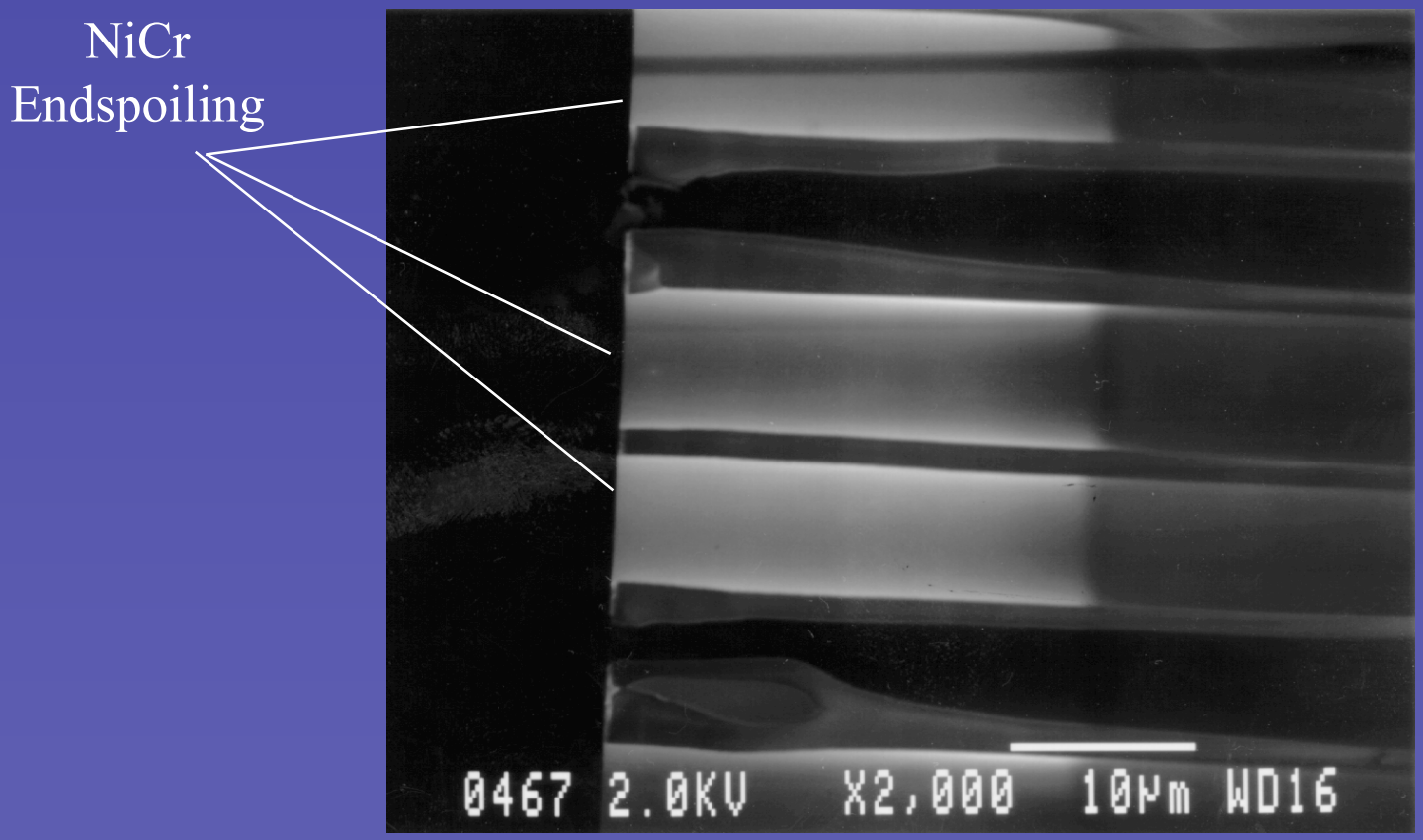

Figure 6

Spot Size, Deep Endspoiling

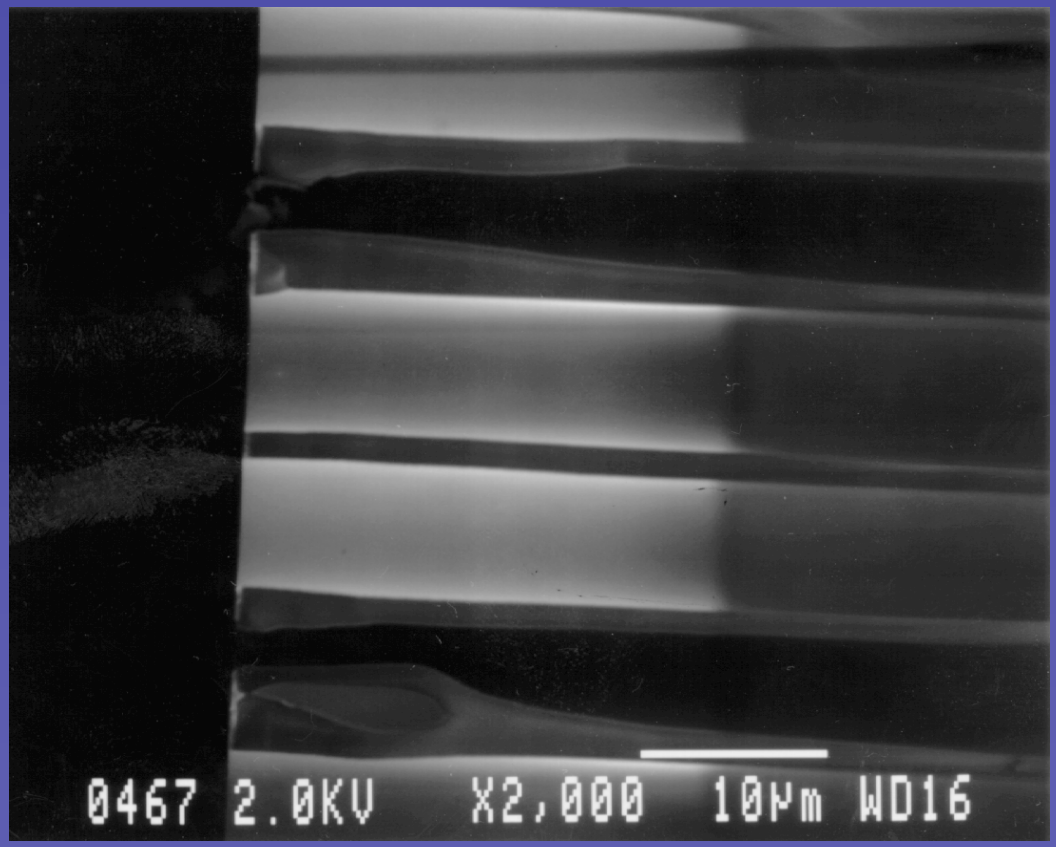

Figure 7

Focal Plane

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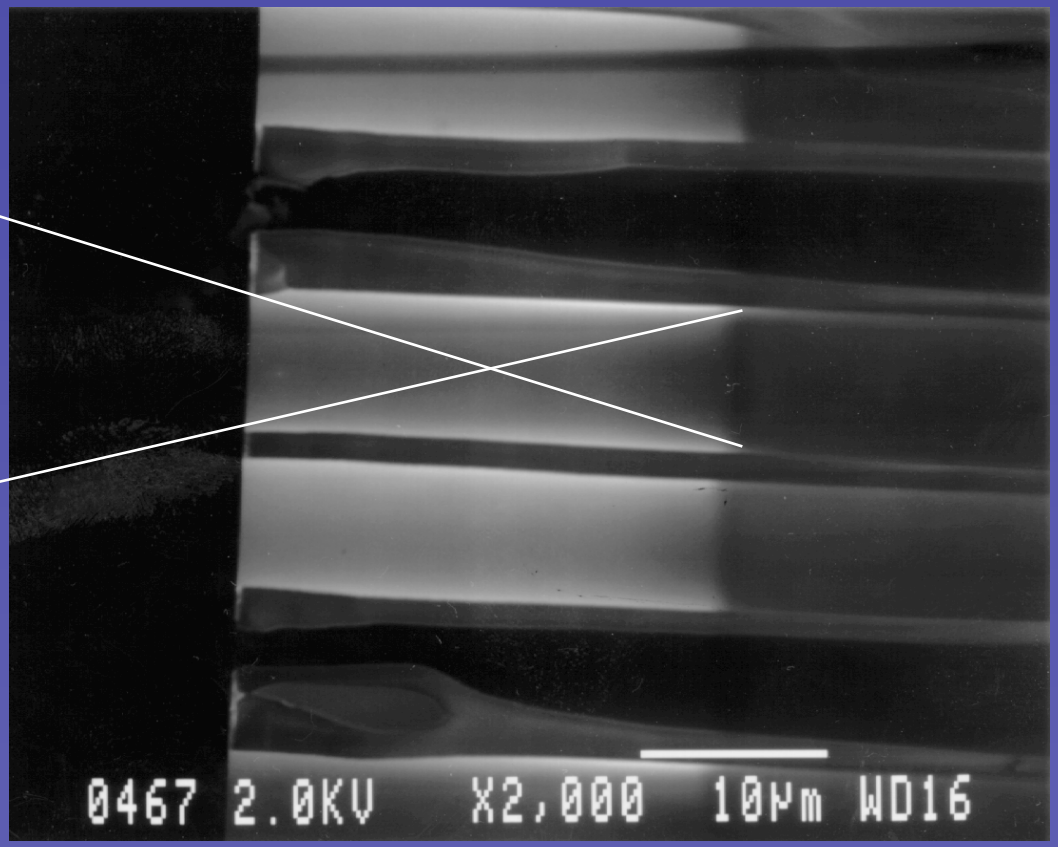
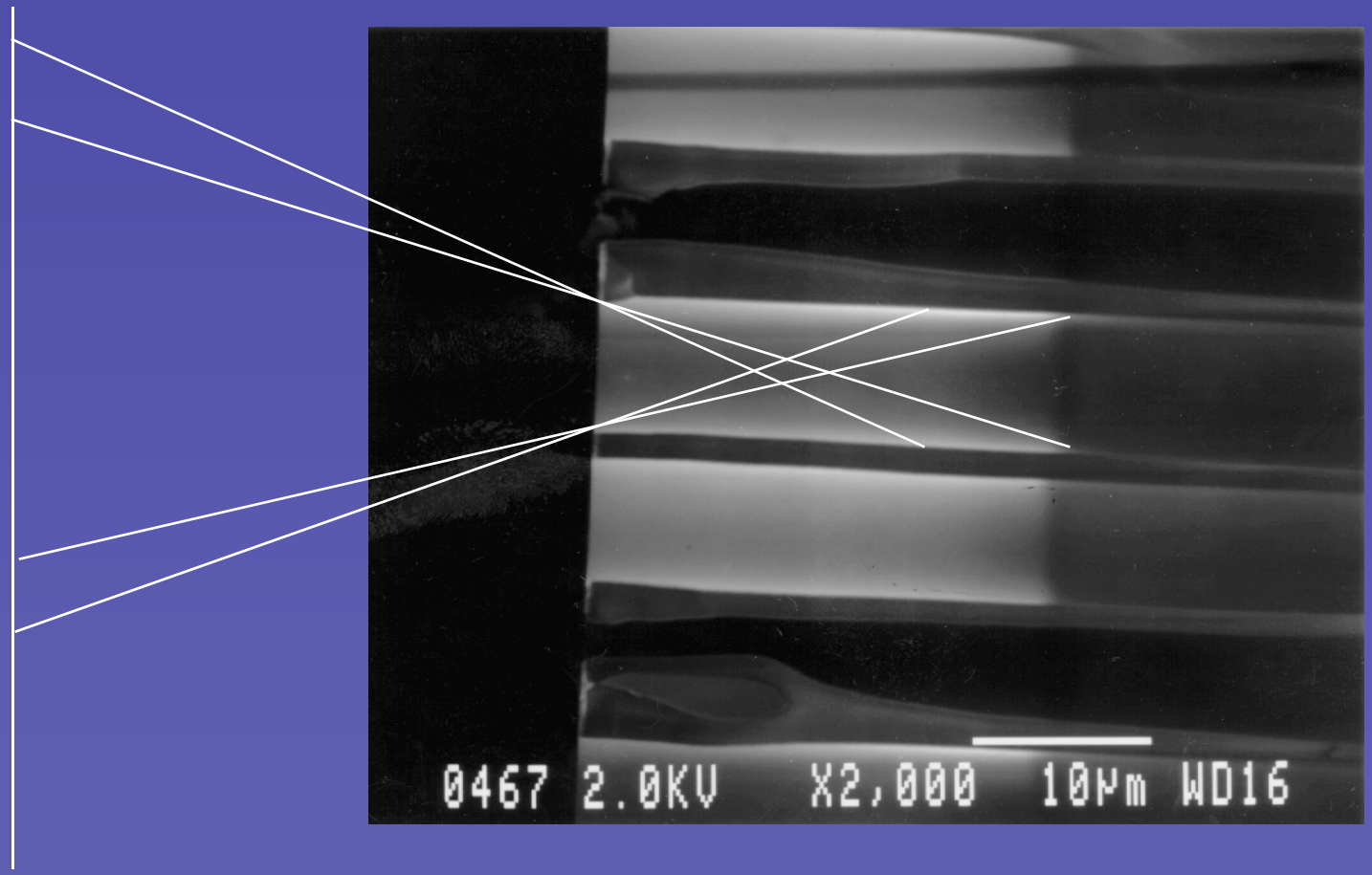
Spot Size, Deep Endspoiling



Focal Plane

Figure 8

Spot Size, Deep Endspoiling



Focal Plane

Figure 9

Spatial Resolution: Theoretical Maximum

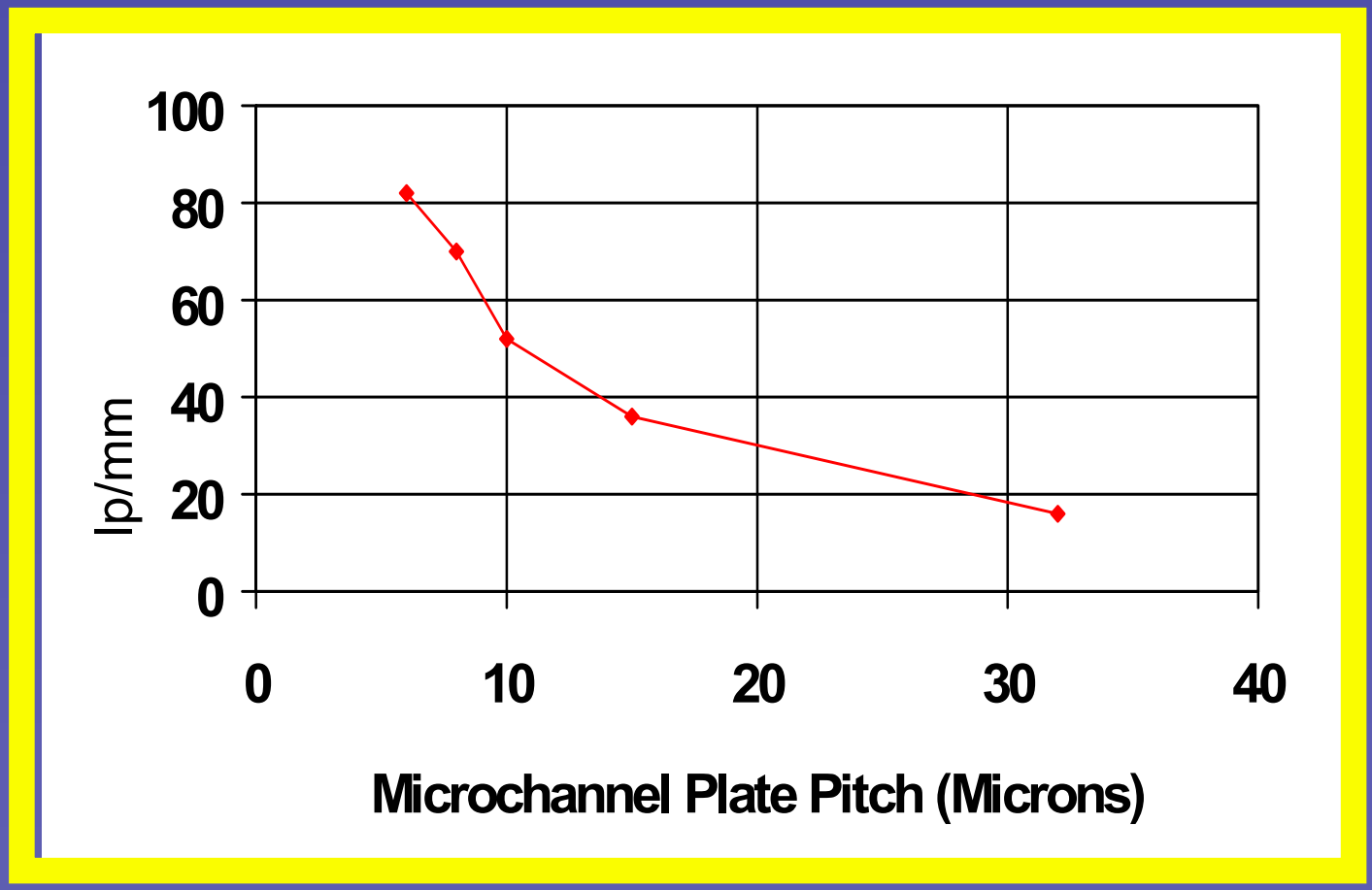


Figure 10

USAF 1951 Resolution Target

Group 5

1 = 32.00 lp/mm

2 = 35.92 lp/mm

3 = 40.64 lp/mm

4 = 45.59 lp/mm

5 = 51.01 lp/mm

6 = 57.01 lp/mm

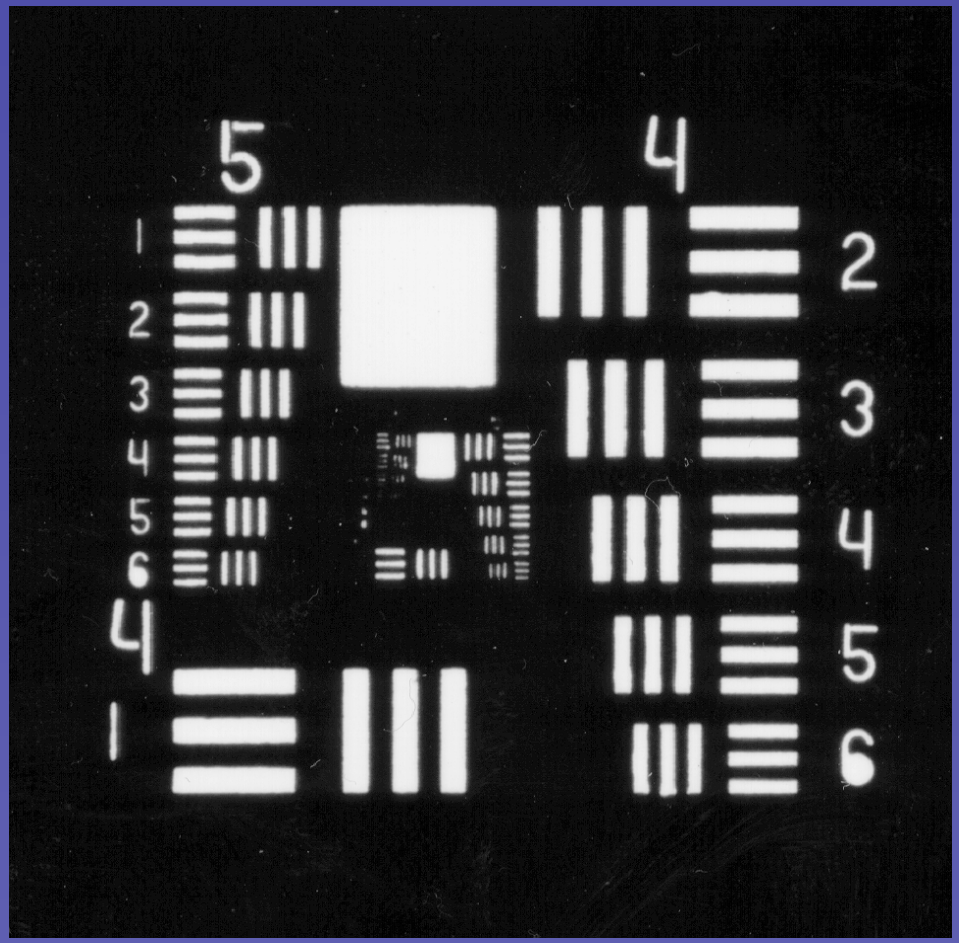
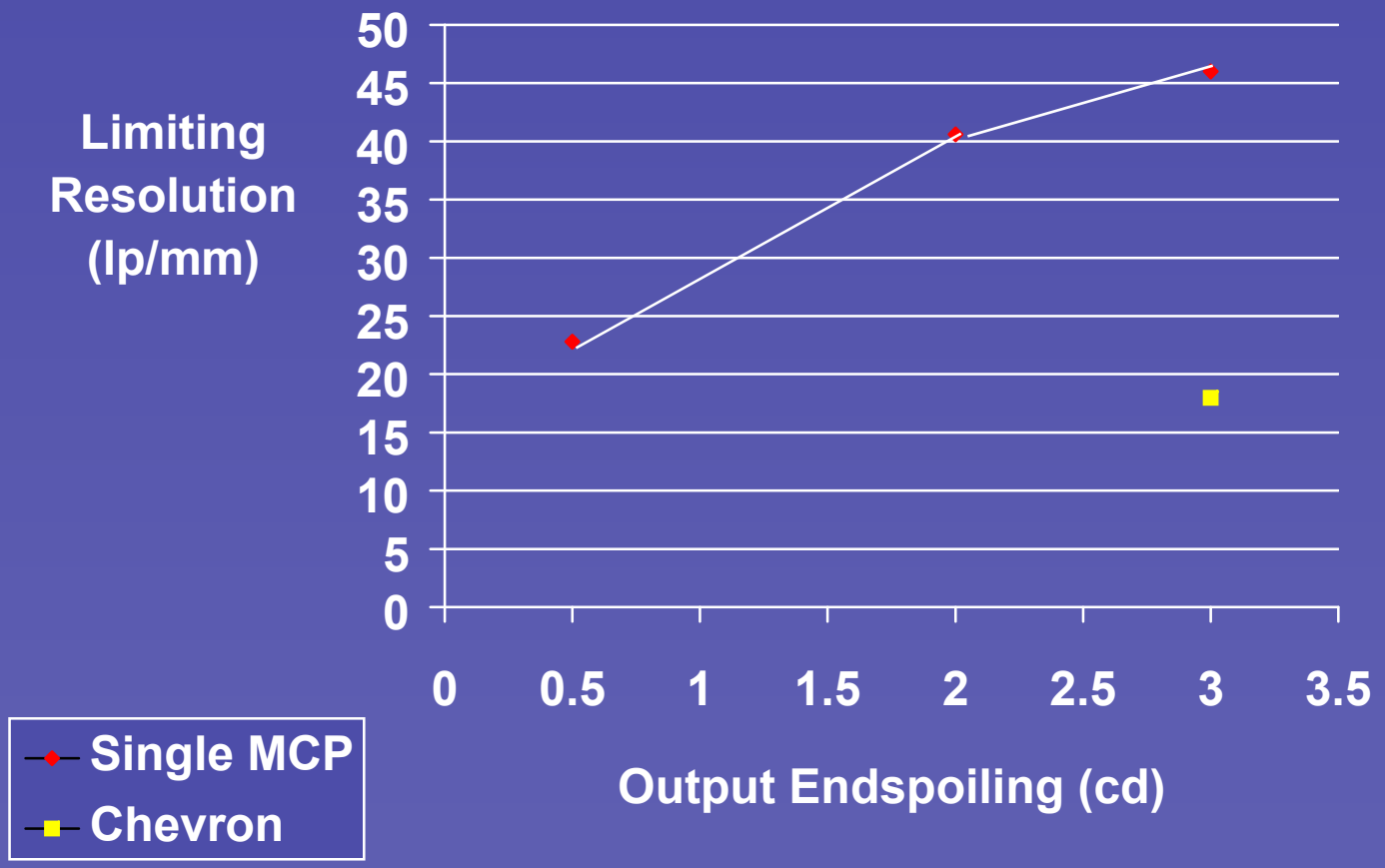


Figure 11

Limiting Spatial Resolution as a Function Of Output Endspoiling (18mm 9.5 um C-C)



Conditions:

MCP to Al. Screen Spacing = .6mm

Phosphor Grain Size 3um

FOFP Pitch 3um

Screen Potential 5Kv

Figure 12

Single Microchannel Plate Gain as a Function Of Output Endspoiling

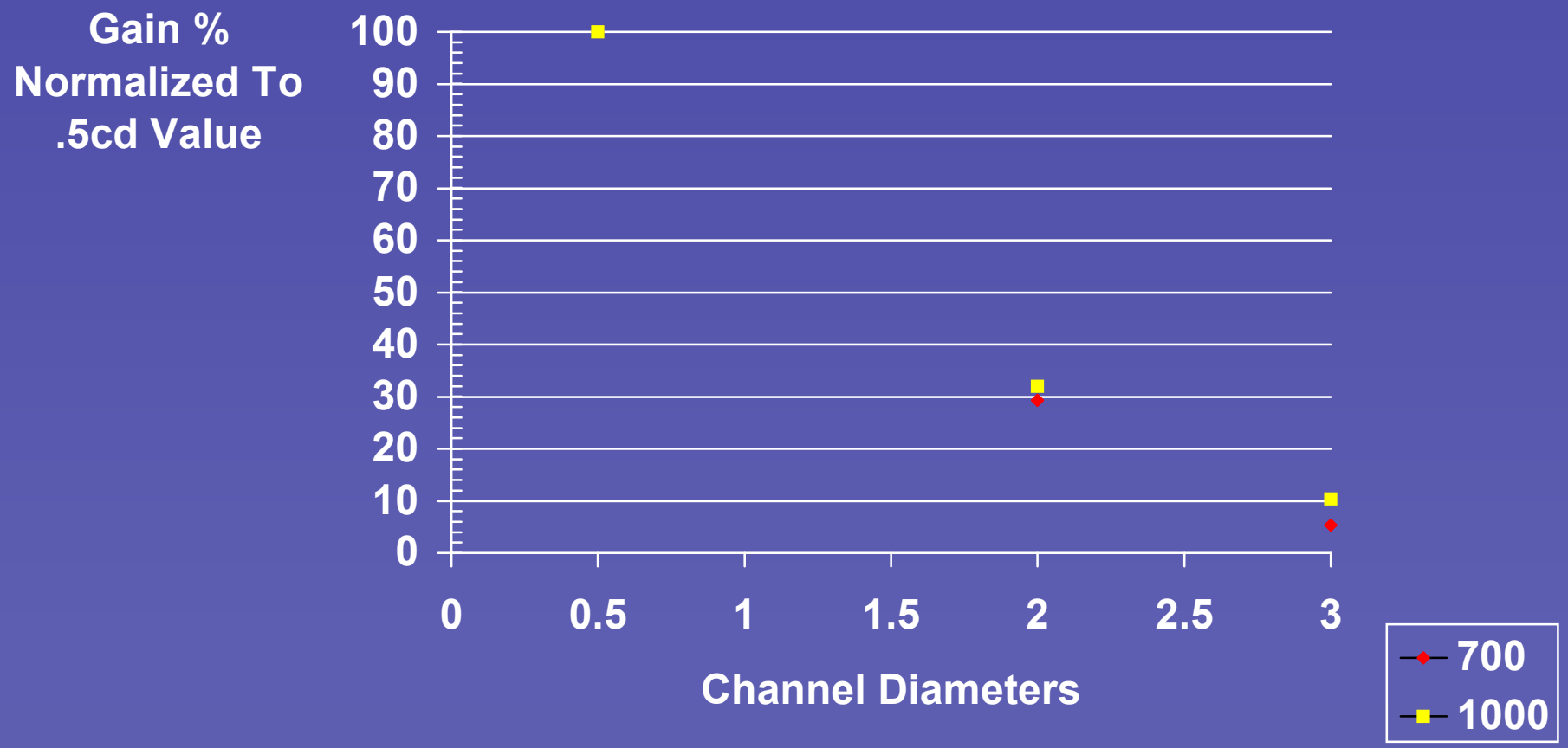


Figure 13

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Chevron Gain as a Function Of Output Endspoiling

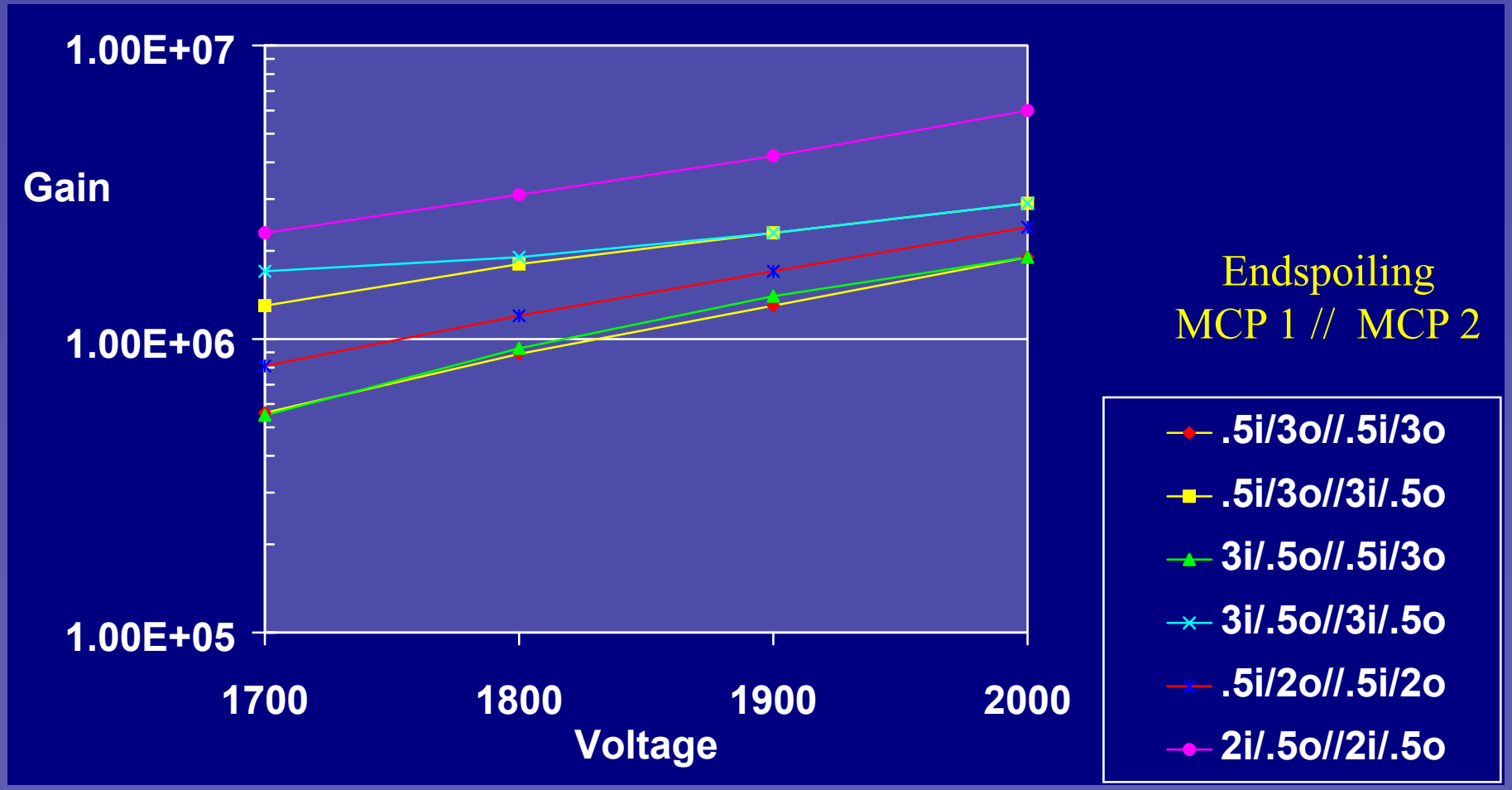

Figure 14

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Chevron Pulse Height Resolution as a Function Of Output Endspoiling

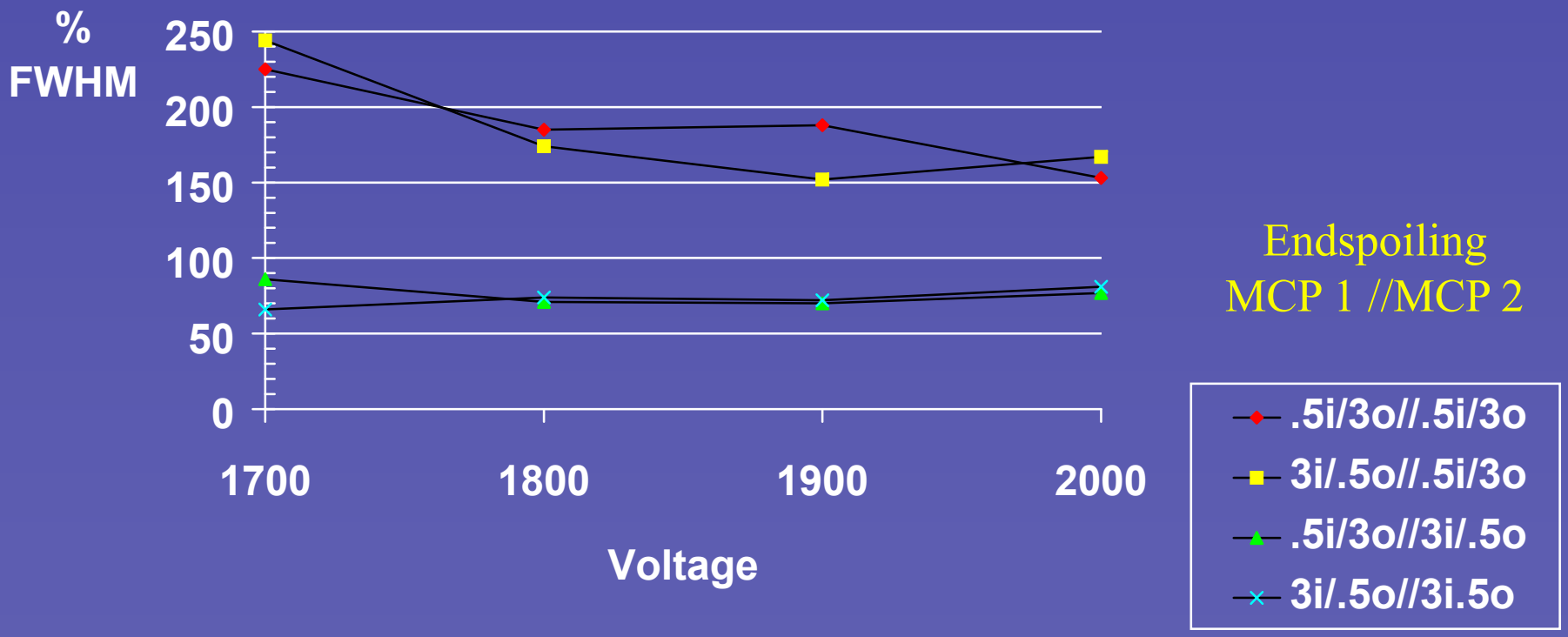

Figure 15

The Effects Of Output Endspoiling On Microchannel Plate Performance

Conclusions:

- The Limiting Spatial Resolution Increases As A Function Of Endspoiling Depth
- Microchannel Plate Gain Decreases As A Function Of Output Endspoiling Depth For Both Single Microchannel Plates and Chevrons
- Pulse Height Resolution Improves with Shallow Output Endspoiling Depth On The Second Microchannel Plate Of The Chevron