



硒化锌 ZnSe 中红外平凸透镜 (AR/AR 涂层 焦距 150mm)



描述

ZnSe 广泛用于红外元件、窗口和透镜以及光谱 ATR 棱镜。硒化锌是 10.6 微米 CO₂ 激光光学器件的 Shou 选材料之一。ZnSe (硒化锌) 化学气相沉积 (CVD) 材料是由锌蒸气和 H₂Se 气体合成而成的, 在石墨基座上形成片状 (ZnSe-CVD 工艺)。CVD-ZnSe 的化学纯度为 99.999%。它具有多晶结构。控制硒化锌 CVD 材料的晶粒尺寸以产生 Max. 的强度和可加工性。ZnSe 在红外元器件窗片透镜以及光谱分析 ATR 棱镜领域有着广泛的应用。硒化锌(Zinc Selenide)对于 CO₂ 激光器的元器件也是一种良好的选择。在 CO₂ 激光器工作的波段 10.6 microns 附近有着良好的透射率。硒化锌材料是一种黄色透明的多晶材料, 结晶颗粒大小约为 70 μm, 透光范围 0.5-15 μm。由化学气相沉积(CVD)方法合成的基本不存在杂质吸收, 散射损失极低。由于对 10.6 μm 波长光的吸收很小, 因此成为制作高功率 CO₂ 激光器系统中光学器件的优选材料。此外在其整个透光波段内, 也是在不同光学系统中所普遍使用的材料。硒化锌材料对热冲击具有很高的承受能力, 使它成为高功率 CO₂ 激光器系统中的优秀光学材料。硬度只是多光谱级 ZnS 的 2/3, 材质较软易产生划痕, 而且材料折射率较大, 所以需要在其表面镀制高硬度减反射膜来加以保护并获得较高的透过率。在其常用光谱范围内, 散射很低。在用做高功率激光器件时, 需要严格控制材料的体吸收和内部结构缺陷, 并采用 Min. 破坏程度的抛光技术和 zui 高光学质量的镀膜工艺。





产品特点

透射波长范围广，高透射率，耐高温，CO₂ 激光器好的光学材料，散射损失低

产品型号

ZNSE25.4LENS150AR

应用领域

CO₂激光器

中红外QCL激光器

中红外激光光路搭建

核心参数

规格尺寸	焦距F.L.	曲率半径
25.4mm	150mm @ 7μm	214.7mm

详细参数

名称	参数
透射范围	0.6~21μm
折射率	2.4028 at 10.6μm
反射损耗	29.1% at 10.6μm
吸收系数	0.0005 cm ⁻¹ @10.6μm
吸收峰	45.7μm



dn/dT	$61 \times 10^{-6}/^{\circ}\text{C}$
dn/du=0	5.5um
密度	5.27g/cc
熔点	1525 $^{\circ}\text{C}$
导热率	$18\text{Wm}^{-1}\text{K}^{-1}$ at 298K
热膨胀	$7.1 \times 10^{-6}/^{\circ}\text{C}$
硬度	Knoop 120
比热容	$339\text{J Kg}^{-1}\text{K}^{-1}$
介电常数	n/a
杨氏模量	67.2GPa
剪切模量	n/a
体积模量	40GPa
弹性系数	Not Available
表现弹性极限	55.1MPa

泊松比	0.28
溶解度	0.001g/100g with, 20°C
分子量	144.33
等级/结构	HIP polycrystalline cubic HIP(热等静压)多晶立方

折射率:(No=Ordinary Ray)

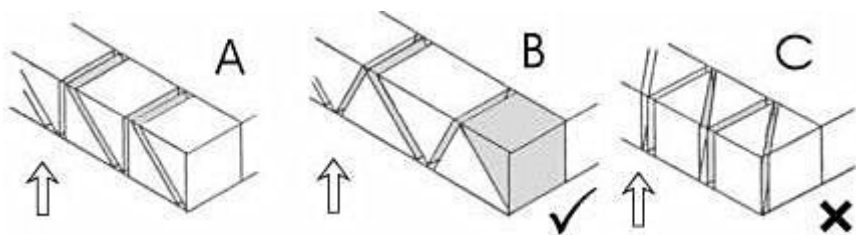
um	No	um	No	um	No
0.54	2.6754	0.58	2.6312	0.62	2.5994
0.66	2.5755	0.7	2.5568	0.74	2.5418
0.78	2.5295	0.82	2.5193	0.86	2.5107
0.90	2.5034	0.94	2.4971	0.98	2.4916
1.0	2.4892	1.4	2.4609	1.8	2.4496
2.2	2.4437	2.6	2.4401	3.0	2.4376
3.4	2.4356	3.8	2.4339	4.2	2.4324

4.6	2.4309	5.0	2.4295	5.4	2.4281
5.8	2.4266	6.2	2.4251	6.6	2.4235
7.0	2.4218	7.4	2.4201	7.8	2.4183
8.2	2.4163	8.6	2.4143	9.0	2.4122
9.4	2.4100	9.8	2.4077	10.2	2.4053
10.6	2.4028	11.0	2.4001	11.4	2.3974
11.8	2.3945	12.2	2.3915	12.6	2.3883
13.0	2.3850	13.4	2.3816	13.8	2.3781
14.2	2.3744	14.6	2.3705	15.0	2.3665
15.4	2.3623	15.8	2.3579	16.2	2.3534
16.6	2.3487	17.0	2.3438	17.4	2.3387
17.8	2.3333	18.2	2.3278		

关于晶体切割:

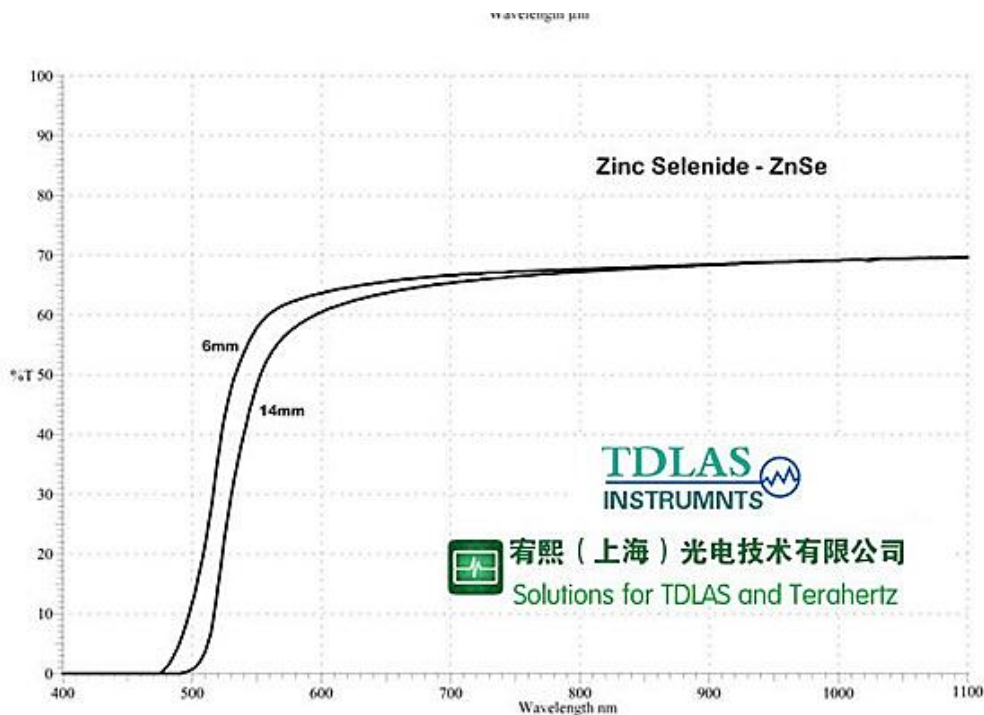
在化学气相沉积过程中，小晶粒与生长方向对齐，并且垂直于所生产的片材的厚度。因此，对于正常厚度和纵横比的窗口，晶粒的排列很少是问题，因为它们是从生长的片材上切割下来的，使得在光学窗口内，晶粒垂直于表面排列。这是内部吸收和散射最低的方向。对于棱镜，切割方向需要更多的考虑。建议带状材料的厚度与棱镜的顶点高度相对应。这确保了大多数常用棱镜应用的好的晶粒取向。

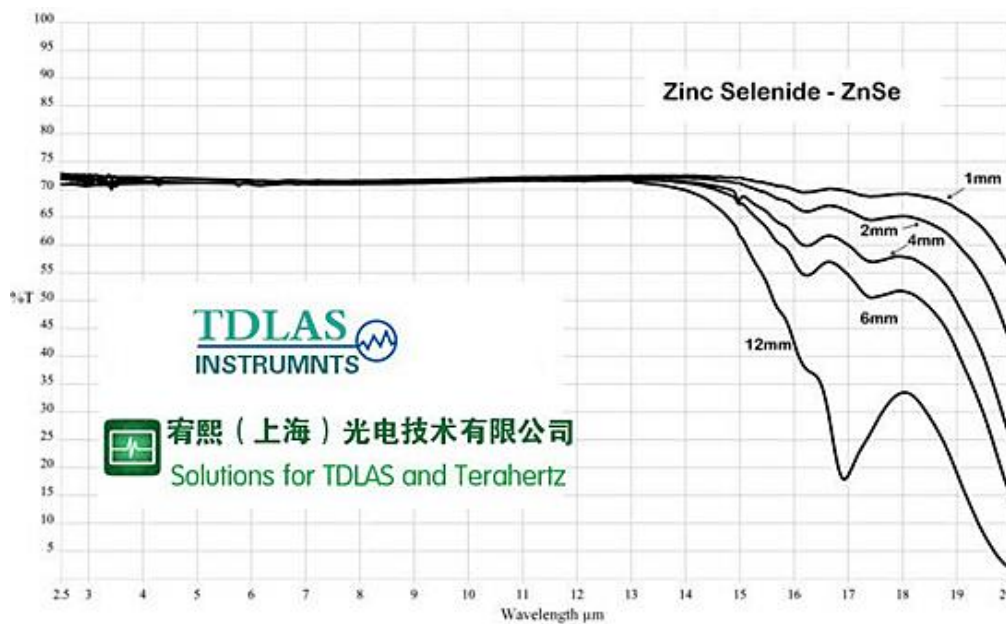
对于典型的 45° 棱镜，最明显的材料使用如 (A) 所示，但应注意的是，这不是好的方向。优秀的选择是 (B)，它也允许对棱镜尺寸有更高的限制，或者反过来允许使用更薄的坯料。带子的末端有废物



特性曲线

光谱透射图曲线





订购信息

订购型号	规格	曲率	焦距	硒化 锌等 级	具体参数												
ZNSE5LE NS400	5.0mm Ø PI ano-Vex 平 凸透镜	562.6 (±0.2m m)	400mm @ 10µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 5.0mm diameter x 400mm nominal F.L. MATERIAL: CVD ZnSe Diameter:5mm (±0.1mm) Clear Aperture:80% of diameter Edge thickness:1.0mm (±0.1mm) Centre Thickness:1.0mm derived Chamfers:approx 0.1mm break-edge Radius of Curvature 1:562.6 (test plate) Radius of Curvature 2:Plano Centration:Not specified Surface Accuracy:Not specified S/D:60/40 Coating:None <table><tr><th colspan="2">Effective Focal length</th></tr><tr><td>0.633nm</td><td>350mm</td></tr><tr><td>1064nm</td><td>378mm</td></tr><tr><td>7µm</td><td>396mm</td></tr><tr><td>10.6µm</td><td>400mm</td></tr><tr><td>14µm</td><td>409mm</td></tr></table>	Effective Focal length		0.633nm	350mm	1064nm	378mm	7µm	396mm	10.6µm	400mm	14µm	409mm
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ZNSE10L ENS10AR	10mm Ø 标 称 AR/AR 涂 层	28.4 (±0.2m m)	10mm @ 7µm	IR 双 凸													
ZNSE13L ENS280	13.0mm Ø	400 (±0.2m m)	280mm @ 10µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 13.0mm diameter x 280mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 13mm (±0.1mm) Clear Aperture: 80% of diameter Edge thickness: 4.0mm (±0.1mm) Centre Thickness: 4.0mm derived Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 400 (±5mm) Radius of Curvature 2: Plano Centration: Not specified Surface Accuracy: Not specified S/D: 60/40 Coating: None <table><tr><th colspan="2">Effective Focal length</th></tr><tr><td>0.633nm</td><td>254mm</td></tr><tr><td>1064nm</td><td>270mm</td></tr><tr><td>7µm</td><td>281mm</td></tr><tr><td>10.6µm</td><td>285mm</td></tr><tr><td>14µm</td><td>291mm</td></tr></table>	Effective Focal length		0.633nm	254mm	1064nm	270mm	7µm	281mm	10.6µm	285mm	14µm	291mm
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ZNSE25. 4LENS25	25.4mm Ø	35.79 (±0.2m m)	25mm @ 5µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 25.4mm diameter x 25mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 25.4mm (±0.1mm) Clear Aperture: 80% of diameter Edge thickness: 2.0mm (±0.1mm) Centre Thickness: 4.3mm derived Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 35.79mm (Test Plate) Radius of Curvature 2: Plano Centration: Not specified Surface Accuracy: Not specified S/D: 60/40 Coating: Uncoated <table><tr><th colspan="2">Effective Focal length</th></tr><tr><td>0.633nm</td><td>22.3mm</td></tr><tr><td>1064nm</td><td>24.0mm</td></tr><tr><td>5µm</td><td>25.0mm</td></tr><tr><td>10.6µm</td><td>25.5mm</td></tr><tr><td>14µm</td><td>26.0mm</td></tr></table>	Effective Focal length		0.633nm	22.3mm	1064nm	24.0mm	5µm	25.0mm	10.6µm	25.5mm	14µm	26.0mm
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14µm	26.0mm																
ZNSE25. 4LENS30	25.4mm Ø	43.07 (±0.2m m)	30mm @ 14µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 25.4mm diameter x 30mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 25.4mm (+0/-0.2mm) Clear Aperture: 80% of diameter Edge thickness: 1.4mm derived Centre Thickness: 3.3mm (±0.2mm) Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 43.07 (±0.2mm) Radius of Curvature 2: Plano Centration: < 5 minutes Surface Accuracy: λ/10 at 10.6µm S/D: 60/40 Coating: Uncoated <table><tr><th colspan="2">Back Focal length</th></tr><tr><td>0.633nm</td><td>26.0mm</td></tr><tr><td>1064nm</td><td>28.1mm</td></tr><tr><td>7µm</td><td>28.9mm</td></tr><tr><td>10.6µm</td><td>29.3mm</td></tr><tr><td>14µm</td><td>29.9mm</td></tr></table>	Back Focal length		0.633nm	26.0mm	1064nm	28.1mm	7µm	28.9mm	10.6µm	29.3mm	14µm	29.9mm
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ZNSE25. 4LENS30 AR	25.4mm Ø AR/AR Coated	43.07 (±0.2m m)	30mm @ 14µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 25.4mm diameter x 30mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 25.4mm (+0/-0.2mm) Clear Aperture 80% of diameter Edge thickness: 1.4mm derived Centre Thickness: 3.3mm (±0.2mm) Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 43.07 (±0.2mm) Radius of Curvature 2: Plano Centration < 5 minutes Surface Accuracy λ/10 at 10.6µm S/D: 60/40 Coating: Uncoated <table><tr><th colspan="2">Back Focal length</th></tr><tr><td>0.633nm</td><td>26.0mm</td></tr><tr><td>1064nm</td><td>28.1mm</td></tr><tr><td>7µm</td><td>28.9mm</td></tr><tr><td>10.6µm</td><td>29.3mm</td></tr><tr><td>14µm</td><td>29.9mm</td></tr></table>	Back Focal length		0.633nm	26.0mm	1064nm	28.1mm	7µm	28.9mm	10.6µm	29.3mm	14µm	29.9mm
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14µm	29.9mm																
ZNSE25. 4LENS65	25.4mm Ø	90.4 (±1mm)	65mm @ 12µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 25.4mm diameter x 30mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 25.4mm (+0/-0.2mm) Clear Aperture 80% of diameter Edge thickness: 1.4mm derived Centre Thickness: 3.3mm (±0.2mm) Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 43.07 (±0.2mm) Radius of Curvature 2: Plano Centration < 5 minutes Surface Accuracy λ/10 at 10.6µm S/D: 60/40 Coating: AR/AR <table><tr><th colspan="2">Back Focal length</th></tr><tr><td>0.633nm</td><td>26.0mm</td></tr><tr><td>1064nm</td><td>28.1mm</td></tr><tr><td>7µm</td><td>28.9mm</td></tr><tr><td>10.6µm</td><td>29.3mm</td></tr><tr><td>14µm</td><td>29.9mm</td></tr></table>	Back Focal length		0.633nm	26.0mm	1064nm	28.1mm	7µm	28.9mm	10.6µm	29.3mm	14µm	29.9mm
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ZNSE25. 4LENS65 AR	25.4mm Ø nominal AR/AR Coated	90.4 (±1mm)	65mm @ 12µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 25.4mm diameter x 65mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 25.4mm (±0.1mm) Clear Aperture 80% of diameter Edge thickness: 2.0mm (±0.1mm) Centre Thickness: 2.9mm derived Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 90.4 (±1mm) Radius of Curvature 2: Plano Centration < 5 minutes Surface Accuracy λ/10 at 10.6µm S/D: 60/40 Coating: AR/AR <table><tr><th colspan="2">Effective Focal length</th></tr><tr><td>0.633nm</td><td>57.4mm</td></tr><tr><td>1064nm</td><td>60.7mm</td></tr><tr><td>7µm</td><td>63.6mm</td></tr><tr><td>10.6µm</td><td>64.4mm</td></tr><tr><td>14µm</td><td>65.8mm</td></tr></table>	Effective Focal length		0.633nm	57.4mm	1064nm	60.7mm	7µm	63.6mm	10.6µm	64.4mm	14µm	65.8mm
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10.6µm	64.4mm																
14µm	65.8mm																
ZNSE25. 4LENS15 0	25.4mm Ø	214.7 (±1mm)	150mm @ 7µm	IR 平 凸													

ZNSE25. 4LENS15 0AR	25.4mm Ø AR/AR coated	214.7 (±1mm)	150mm @ 7µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 25.4mm diameter x 150mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 25.4mm (±0.1mm) Clear Aperture 80% of diameter Edge thickness: 2.0mm (±0.1mm) Centre Thickness: 2.4mm derived Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 214.7 (±1mm) Radius of Curvature 2: Plano Centration < 5 minutes Surface Accuracy λ/10 at 10.6µm S/D: 60/40 Coating: AR/AR <table><tr><th colspan="2">Effective Focal length</th></tr><tr><td>0.633nm</td><td>134.3mm</td></tr><tr><td>1064nm</td><td>144.2mm</td></tr><tr><td>7µm</td><td>151.1mm</td></tr><tr><td>10.6µm</td><td>153.1mm</td></tr><tr><td>14µm</td><td>156.3mm</td></tr></table>	Effective Focal length		0.633nm	134.3mm	1064nm	144.2mm	7µm	151.1mm	10.6µm	153.1mm	14µm	156.3mm
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ZNSE25. 4LENS19 5	25.4mm Ø	272.7 (±1mm)	195mm @ 12µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 25.4mm diameter x 195mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 25.4mm (±0.1mm) Clear Aperture 80% of diameter Edge thickness: 2.0mm (±0.1mm) Centre Thickness: 2.3mm derived Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 272.7 (±1mm) Radius of Curvature 2: Plano Centration < 5 minutes Surface Accuracy λ/10 at 10.6µm S/D: 60/40 Coating: Uncoated <table><tr><th colspan="2">Effective Focal length</th></tr><tr><td>0.633nm</td><td>170.5mm</td></tr><tr><td>1064nm</td><td>183.1mm</td></tr><tr><td>7µm</td><td>191.8mm</td></tr><tr><td>10.6µm</td><td>194.4mm</td></tr><tr><td>14µm</td><td>198.4mm</td></tr></table>	Effective Focal length		0.633nm	170.5mm	1064nm	183.1mm	7µm	191.8mm	10.6µm	194.4mm	14µm	198.4mm
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ZNSE25. 4LENS19 5AR	25.4mm Ø	272.7 (±1mm)	195mm @ 12µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 25.4mm diameter x 195mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 25.4mm (±0.1mm) Clear Aperture 80% of diameter Edge thickness: 2.0mm (±0.1mm) Centre Thickness: 2.3mm derived Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 272.7 (±1mm) Radius of Curvature 2: Plano Centration < 5 minutes Surface Accuracy λ/10 at 10.6µm S/D: 60/40 Coating: AR/AR <table><tr><th colspan="2">Effective Focal length</th></tr><tr><td>0.633nm</td><td>170.5mm</td></tr><tr><td>1064nm</td><td>183.1mm</td></tr><tr><td>7µm</td><td>191.8mm</td></tr><tr><td>10.6µm</td><td>194.4mm</td></tr><tr><td>14µm</td><td>198.4mm</td></tr></table>	Effective Focal length		0.633nm	170.5mm	1064nm	183.1mm	7µm	191.8mm	10.6µm	194.4mm	14µm	198.4mm
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ZNSE25. 4LENS25 0	25.4mm Ø	350 (±1mm)	250mm @ 12µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 25.4mm diameter x 250mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 25.4mm (±0.1mm) Clear Aperture: 80% of diameter Edge thickness: 2.0mm (±0.1mm) Centre Thickness: 2.2mm derived Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 350 (±1mm) Radius of Curvature 2: Plano Centration: < 5 minutes Surface Accuracy: λ/10 at 10.6µm S/D: 60/40 Coating: Uncoated <table><tr><th colspan="2">Effective Focal length</th></tr><tr><td>0.633nm</td><td>218.8mm</td></tr><tr><td>1064nm</td><td>235.0mm</td></tr><tr><td>7µm</td><td>246.2mm</td></tr><tr><td>10.6µm</td><td>249.5mm</td></tr><tr><td>14µm</td><td>254.7mm</td></tr></table>	Effective Focal length		0.633nm	218.8mm	1064nm	235.0mm	7µm	246.2mm	10.6µm	249.5mm	14µm	254.7mm
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ZNSE25. 4LENS25 0AR	25.4mm Ø nominal AR/AR Coated	350 (±1mm)	250mm @ 12µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 25.4mm diameter x 250mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 25.4mm (±0.1mm) Clear Aperture: 80% of diameter Edge thickness: 2.0mm (±0.1mm) Centre Thickness: 2.2mm derived Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 350 (±1mm) Radius of Curvature 2: Plano Centration: < 5 minutes Surface Accuracy: λ/10 at 10.6µm S/D: 60/40 Coating: AR/AR <table><tr><th colspan="2">Effective Focal length</th></tr><tr><td>0.633nm</td><td>218.8mm</td></tr><tr><td>1064nm</td><td>235.0mm</td></tr><tr><td>7µm</td><td>246.2mm</td></tr><tr><td>10.6µm</td><td>249.5mm</td></tr><tr><td>14µm</td><td>254.7mm</td></tr></table>	Effective Focal length		0.633nm	218.8mm	1064nm	235.0mm	7µm	246.2mm	10.6µm	249.5mm	14µm	254.7mm
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ZNSE25. 4LENS50 0	25.4mm Ø	703.1 (±1mm)	500mm @ 10µm	IR 平 凸	ZINC SELENIDE PLANO-CONVEX LENS 25.4mm diameter x 500mm nominal F.L. MATERIAL: CVD ZnSe Diameter: 25.4mm (±0.1mm) Clear Aperture: 80% of diameter Edge thickness: 2.0mm (±0.1mm) Centre Thickness: 2.2mm derived Chamfers: approx 0.1mm break-edge Radius of Curvature 1: 703.1 (±1mm) Radius of Curvature 2: Plano Centration: < 5 minutes Surface Accuracy: λ/10 at 10.6µm S/D: 60/40 Coating: Uncoated <table><tr><th colspan="2">Effective Focal length</th></tr><tr><td>0.633nm</td><td>446.3mm</td></tr><tr><td>1064nm</td><td>472.1mm</td></tr><tr><td>7µm</td><td>494.5mm</td></tr><tr><td>10.6µm</td><td>501.2mm</td></tr><tr><td>14µm</td><td>511.6mm</td></tr></table>	Effective Focal length		0.633nm	446.3mm	1064nm	472.1mm	7µm	494.5mm	10.6µm	501.2mm	14µm	511.6mm
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CAF25LE NS100U	25mm Ø (请确认厂家 是否在售)	43.73 (±2%)	100mm @ 350nm	IR 平 凸	
CAF25LE NS130	25mm Ø	55.35 (±2%)	130mm @ 3μm	IR 平 凸	
CAF25LE NS150	25mm Ø	61.0 (±2%)	150mm @ 5μm	IR 平 凸	
CAF25LE NS150U	25mm Ø (请确认厂家 是否在售)	69.75 (±2%)	150mm @ 350nm	IR 平 凸	
CAF25LE NS200U	25mm Ø (请确认厂家 是否在售)	90.39 (±2%)	200mm @ 350nm	IR 平 凸	
CAF25LE NS300	25mm Ø	120.0 (±2%)	300mm @ 5μm	IR 平 凸	
CAF25LE NS500	25mm Ø	202.02 (±2%)	500mm @ 5μm	IR 平 凸	

CAF25.4 LENS200	25.4mm Ø	80.7 (±2%)	200mm @ 5μm	IR 平 凸	
CAF27LE NS50	27mm Ø	43.10 (±2%)	50mm @ 3μm	IR 平 凸	
CAF30LE NS70	30mm Ø	57.00 (±2%)	70mm @ 4μm	IR 平 凸	
CAF31.5 LENS60	31.5mm Ø	27.50 (±2%)	60mm @ 3μm	IR 平 凸	
CAF38.1 LENS75	38.1mm Ø	33.84 (±2%)	75mm @ 4.5μm	IR 平 凸	
CAF38.1 LENS75U	38.1mm Ø (请确认厂家 是否在售)	33.84 (±2%)	66mm @ 248nm	IR 平 凸	
CAF38.1 LENS160	38.1mm Ø	68.16 (±2%)	160mm @ 3μm	IR 平 凸	
CAF38.1 LENS250 U	38.1mm Ø (请确认厂家 是否在售)	100 (±2%)	215mm @ 248nm	IR 平 凸	

CAF38.1 LENS475	38.1mm Ø	190.35 (±2%)	475mm @ 5μm	IR 平 凸	
CAF40LE NS120	40mm Ø	50.25 (±2%)	120mm @ 3μm	IR 平 凸	
CAF40LE NS150	40mm Ø	64 (±2%)	150mm @ 3μm	IR 平 凸	
CAF40LE NS200	40mm Ø	85 (±2%)	200mm @ 3μm	IR 平 凸	
CAF40LE NS330	40mm Ø	138 (±2%)	330mm @ 3μm	IR 平 凸	
CAF40LE NS440	40mm Ø	187 (±2%)	440mm @ 3μm	IR 平 凸	
CAF50LE NS80	50mm Ø	65.6 (±2%)	80mm @ 5μm	IR 平 凸	
CAF50LE NS100	50mm Ø	43.0 (±2%)	100mm @ 1μm	IR 平 凸	
CAF50LE NS135	50mm Ø	57.0 (±2%)	135mm @ 5μm	IR 平 凸	

CAF50LE	50mm Ø	198.9	250mm	IR 平	
NS250		(±2%)	@ 5μm	凸	