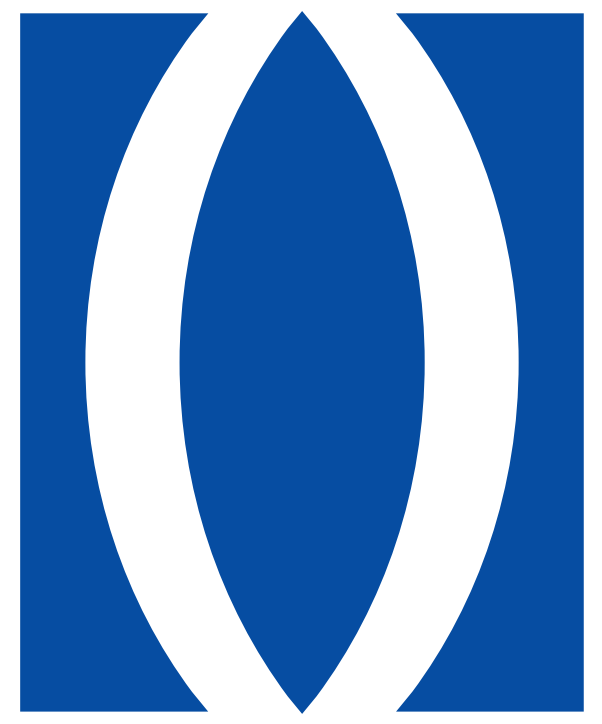




# Spectac



THE QUEEN'S AWARDS FOR ENTERPRISE:

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[He]2s<sup>2</sup>2p<sup>4</sup> 15.999</td><td><b>F</b> Fluorine [He]2s<sup>2</sup>2p<sup>5</sup> 18.998</td><td><b>Ne</b> Neon [He]2s<sup>2</sup>2p<sup>6</sup> 20.18</td></tr> <tr><td><b>Al</b> Aluminum [Ne]3s<sup>2</sup>3p<sup>1</sup> 26.982</td><td><b>Si</b> Silicon [Ne]3s<sup>2</sup>3p<sup>2</sup> 28.085</td><td><b>P</b> Phosphorus [Ne]3s<sup>2</sup>3p<sup>3</sup> 30.974</td><td><b>S</b> Sulfur [Ne]3s<sup>2</sup>3p<sup>4</sup> 32.068</td><td><b>Cl</b> Chlorine [Ne]3s<sup>2</sup>3p<sup>5</sup> 35.452</td><td><b>Ar</b> Argon [Ne]3s<sup>2</sup>3p<sup>6</sup> 39.948</td></tr> <tr><td><b>Ga</b> Gallium [Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>1</sup> 69.723</td><td><b>Ge</b> Germanium [Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>2</sup> 72.63</td><td><b>As</b> Arsenic [Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>3</sup> 74.922</td><td><b>Se</b> Selenium [Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>4</sup> 78.971</td><td><b>Br</b> Bromine [Ar]3d<sup>10</sup>4s<sup>2</sup>4p<sup>5</sup> 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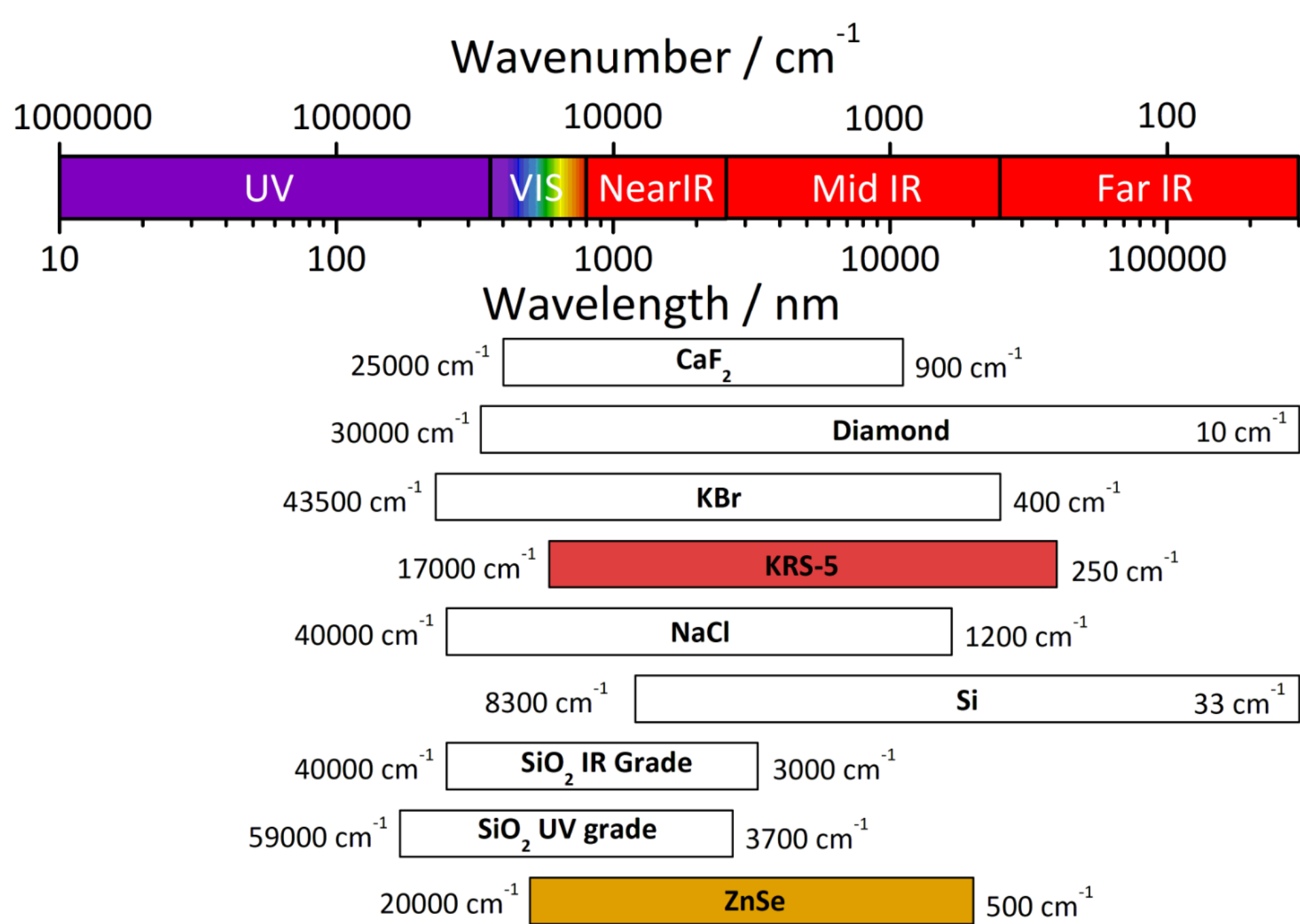
## Lanthanides

<b>La</b> Lanthanum [Xe]5d <sup>1</sup> 6s <sup>2</sup> 138.905	<b>Ce</b> Cerium [Xe]4f <sup>1</sup> 5d <sup>1</sup> 6s <sup>2</sup> 140.116	<b>Pr</b> Praseodymium [Xe]4f <sup>3</sup> 6s <sup>2</sup> 140.908	<b>Nd</b> Neodymium [Xe]4f <sup>4</sup> 6s <sup>2</sup> 144.242	<b>Pm*</b> Promethium [Xe]4f <sup>5</sup> 6s <sup>2</sup> (145)	<b>Sm</b> Samarium [Xe]4f <sup>6</sup> 6s <sup>2</sup> 150.362	<b>Eu</b> Europium [Xe]4f <sup>7</sup> 6s <sup>2</sup> 151.964	<b>Gd</b> Gadolinium [Xe]4f <sup>7</sup> 5d <sup>1</sup> 6s <sup>2</sup> 157.253	<b>Tb</b> Terbium [Xe]4f <sup>9</sup> 6s <sup>2</sup> 158.925	<b>Dy</b> Dysprosium [Xe]4f <sup>10</sup> 6s <sup>2</sup> 162.5	<b>Ho</b> Holmium [Xe]4f <sup>11</sup> 6s <sup>2</sup> 164.93	<b>Er</b> Erbium [Xe]4f <sup>12</sup> 6s <sup>2</sup> 167.259	<b>Tm</b> Thulium [Xe]4f <sup>13</sup> 6s <sup>2</sup> 168.934	<b>Yb</b> Ytterbium [Xe]4f <sup>14</sup> 6s <sup>2</sup> 173.054	<b>Lu</b> Lutetium [Xe]4f <sup>14</sup> 5d <sup>1</sup> 6s <sup>2</sup> 174.967
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## Actinides

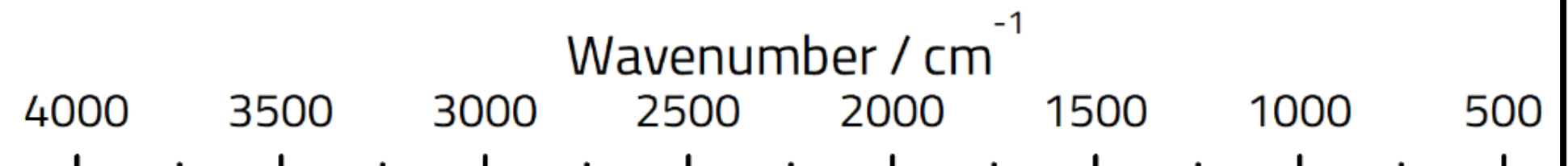
<b>Ac*</b> Actinium [Rn]6d <sup>1</sup> 7s <sup>2</sup> (227)	<b>Th*</b> Thorium [Rn]6d <sup>2</sup> 7s <sup>2</sup> 232.038	<b>Pa*</b> Protactinium [Rn]5f <sup>2</sup> 6d <sup>1</sup> 7s <sup>2</sup> 231.036	<b>U*</b> Uranium [Rn]5f <sup>3</sup> 6d <sup>1</sup> 7s <sup>2</sup> 238.03	<b>Np*</b> Neptunium [Rn]5f <sup>4</sup> 6d <sup>1</sup> 7s <sup>2</sup> (237)	<b>Pu*</b> Plutonium [Rn]5f <sup>6</sup> 7s <sup>2</sup> (244)	<b>Am*</b> Americium [Rn]5f <sup>7</sup> 7s <sup>2</sup> (243)	<b>Cm**</b> Curium [Rn]5f <sup>8</sup> 6d <sup>1</sup> 7s <sup>2</sup> (247)	<b>Bk**</b> Berkelium [Rn]5f <sup>9</sup> 7s <sup>2</sup> (247)	<b>Cf**</b> Californium [Rn]5f <sup>10</sup> 7s <sup>2</sup> (251)	<b>Es**</b> Einsteinium [Rn]5f <sup>11</sup> 7s <sup>2</sup> (252)	<b>Fm**</b> Fermium [Rn]5f <sup>12</sup> 7s <sup>2</sup> (257)	<b>Md**</b> Mendelevium [Rn]5f <sup>13</sup> 7s <sup>2</sup> (258)	<b>No**</b> Nobelium [Rn]5f <sup>14</sup> 7s <sup>2</sup> (259)	<b>Lr**</b> Lawrencium [Rn]5f <sup>14</sup> 7s <sup>2</sup> 7p <sup>1</sup> (266)
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## Common Window/ATR Crystal Guide



Window	Notes
CaF <sub>2</sub>	Insoluble in water, resists most acids and alkalis. Soluble in ammonium salts and attacked by HNO <sub>3</sub> . Its high mechanical strength makes it particularly useful for high pressure work. Sensitive to mechanical and thermal shock. Does not fog.
Diamond	Very hard and extremely chemically resistant. A diamond window is often chosen for high pressure applications. Excellent for ATR work. Has a strong phonon band between 1800-2700 cm <sup>-1</sup> .
KBr	Hygroscopic material similar to NaCl. Soluble in water, glycerine and alcohols. Slightly soluble in ether. Fairly good resistance to mechanical and thermal shock.
KRS-5	Extremely toxic including by skin contact avoid contact with bare skin. This material is a mixture of Thallium Bromide and Thallium Iodide salts. Orange/red in colour. Slightly soluble in water, soluble in bases, but not soluble in acids.
NaCl	Soluble in water and glycerine. Slightly soluble in alcohols. Fair resistance to mechanical and thermal shock and can be easily polished.
Si	Very hard, but brittle and relatively inert material. Is attacked by a combination of HF and HNO <sub>3</sub> . Withstands thermal shock. Useful for Far IR. Has a strong band between 630-590 cm <sup>-1</sup> .
SiO <sub>2</sub>	Resistant to acids and alkalis and unaffected by most solvents.
ZnSe	Toxic, hard and brittle material. Amber/yellow in colour. Insoluble in water, but attacked by strong acids (pH<4) and bases (pH>11) producing toxic gases. Organic solvents have no effect. Ideal for ATR work.

## IR Characteristic Group Frequencies



<b>Alkane</b>	$\overset{S}{\text{---}} \nu(\text{C-H})$	$\delta(\text{C-H}) \overset{M}{\text{---}} \delta(\text{C(H)}_2\text{-H})$
<b>Alkene</b>	$\overset{M}{\text{---}} \nu(\text{C=C})$	$\nu(\text{C=C}) \overset{S}{\text{---}}$ $\delta(\text{C-H}) \overset{M}{\text{---}}$
<b>Alkyne</b>	$\overset{M}{\text{---}} \nu(\equiv\text{C-H})$	$\overset{W}{\text{---}} \nu(\equiv\text{C=C})$ $\delta(\equiv\text{C-H}) \overset{M}{\text{---}}$
<b>Aromatic</b>	$\overset{S}{\text{---}} \nu(\equiv\text{C-H})$	$\nu(\equiv\text{C=C}) \overset{M}{\text{---}}$ $\delta(\text{C-H}) \overset{V}{\text{---}}$
<b>Alcohol</b>	$\overset{S,B}{\text{---}} \nu(\text{O-H/PhO-H})$	$\delta(\text{O-H}) \overset{M}{\text{---}}$ $\delta(\text{PhO-H}) \overset{S}{\text{---}}$
<b>Aldehyde/Ketone</b>		$\nu(\text{C=O}) \overset{S}{\text{---}}$
<b>Ester</b>		$\nu(\text{C=O}) \overset{S}{\text{---}}$ $\nu(\text{C-O-C}) \overset{S}{\text{---}}$
<b>Carboxylic Ac.</b>	$\overset{S,B}{\text{---}} \nu(\text{O-H})$	$\nu(\text{C=O}) \overset{S}{\text{---}}$ $\delta(\text{O-H}) \overset{M}{\text{---}}$ $\overset{M}{\text{---}} \nu(\text{C-O}) \overset{M}{\text{---}}$ $\delta(\text{O-H}) \overset{M}{\text{---}}$
<b>Carboxylic Acid Anhydride</b>		$\nu(\text{C=O}) \overset{S}{\text{---}}$ $\overset{S,B}{\text{---}} \nu(\text{OC-O-CO})$
<b>Amine:</b>	$\overset{M}{\text{---}} \nu(\text{N-H})$	$\delta(\text{N-H}) \overset{M}{\text{---}}$ $\overset{M}{\text{---}} \nu(\text{C-N}) \overset{M}{\text{---}}$ $\delta(\text{N-H}) \overset{M}{\text{---}}$
<b>N Compounds</b>	$\nu(\text{C}\equiv\text{N}) \overset{W}{\text{---}}$	$\nu(\text{C=N}) \overset{M}{\text{---}}$ $\nu(\text{N-O}) \overset{S}{\text{---}}$ $\nu(\text{N-O}) \overset{S}{\text{---}}$
	$\nu(\text{N=N=N}) \overset{S}{\text{---}}$ $\nu(\text{N=C=O}) \overset{S}{\text{---}}$ $\nu(\text{S-C}\equiv\text{N}) \overset{S}{\text{---}}$	
	$\nu(\text{S=C=N}) \overset{S}{\text{---}}$	

<b>Key</b>
$\nu$ – Stretch
$\delta$ – Bend
S – Strong
M – Medium
W – Weak
B – Broad

<b>Alkyl Halide</b>	$\nu(\text{C-F}) \overset{S}{\text{---}}$	$\nu(\text{C-Cl}) \overset{S}{\text{---}}$	$\nu(\text{C-Br}) \overset{S}{\text{---}}$	$\nu(\text{C-I}) \overset{S}{\text{---}}$
<b>S Compounds</b>	$\overset{W}{\text{---}} \nu(\text{S-H})$	$\nu(\text{S=O}) \overset{S}{\text{---}}$	$\nu(\text{S=C}) \overset{W}{\text{---}}$	$\nu(\text{S-C}) \overset{M}{\text{---}}$

