

X-ray Optics components

In this lesson, we shall review common optics components found on X-ray beam-lines.

Mirror (flat), Mirror_curved, Multilayer_elliptic, TwinKB_ML (multi-layer)

Mirrors are reflecting surfaces, e.g. coated with Rh, Ir, Pd, Pt. There are a number of geometry variants.

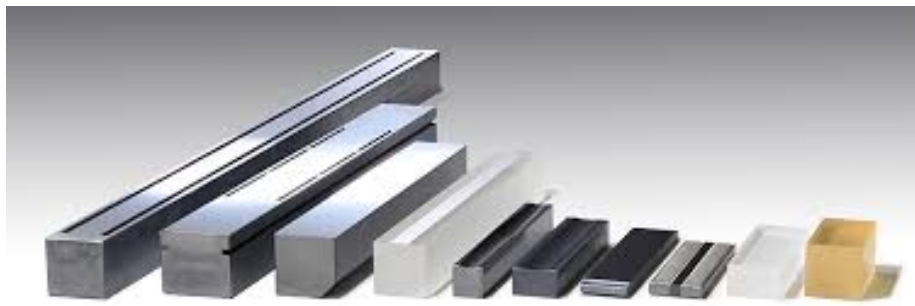


Figure 1: Mirror

Syntax is:

```
Mirror(xwidth=5e-2, zdepth=2e-1, R0=1, coating="B4C.dat")
```

Most beam-lines use mirrors of all kinds.

Refer to e.g. `Tests_optics/Test_Mirrors` for examples.

Slit Beamstop Mask

The slits are very useful to shape the beam, that is absorb some of it, outside, to leave a given section.

```
Slit(xmin=-0.01, xmax=0.01, ymin=-0.01, ymax=0.01)
```

You will find these in all X-ray set-ups.

The Beam stop is the opposite of the Slit. It absorbs all in a given area. The Mask is a matrix of absorbing material dots which are specified via a simple text file.

Bragg_crystal (monochromator, incl. Bragg_crystal_bent)

This is a crystalline material, e.g. Si, that may be lying on a flat or bent surface. In practice the Bragg law:



Figure 2: Slit

$$n\lambda = 2d\sin(\theta)$$

is responsible for a beam $2\text{-}\theta$ deviation in angle wrt the monochromator normal. A pair of similar blades can be used so that the outgoing beam is parallel to the incoming one.

The syntax for such optics is

```
Bragg_crystal(length=0.05, width=0.02, V=160.1826, h=1, k=1, l=1, alpha=0)
```

You will find examples in `Tests_optics/Test_Mono`, `Tests_optics/Template_DCM` (double monochromator) and many SOLEIL beam-lines.

Capillary

This is a thin tube (glass, quartz) in which samples (e.g a small single crystal, a powder, a liquid) can be inserted.

A typical usage is:

```
Capillary(radius=1e-4, length=0.1, R0=0, coating="Rh.txt")
```

You will find an example use in `Tests_optics/Test_capillary`.

Filter (absorption and refraction)

This is a block/slab of attenuating material. The transmission changes as a function of the energy, so that a range in the spectra can be shielded. This



Figure 3: Monok



Figure 4: Capillary

component can advantageously be replaced with the **Fluorescence** sample (to model any material) except for refraction.

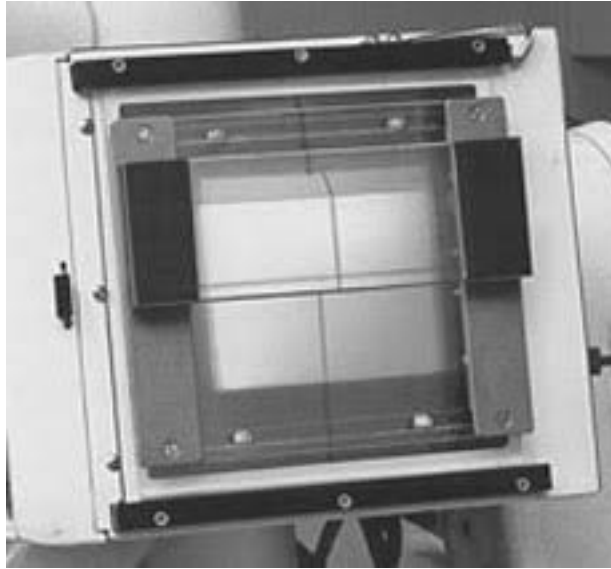


Figure 5: Filter

The syntax for such optics is

```
Filter(material_datafile="Ge.txt", geometry="wire.ply", xwidth=0.02, yheight=0, zdepth=0)
```

You may find usage examples in NBI/NBI_Lab_TOMO, SOLEIL/SOLEIL_ANATOMIX and Tests_optics/Test_Filter.

Lens_simple

This is a block of material with high refractive index, shaped in cylindrical, spherical or parabolic geometry. It is used as a focusing device, to reduce the beam waist (e.g. focus at the sample).

A syntax example is

```
Lens_simple(xwidth=1e-5, yheight=1e-5, material_datafile="Be.txt", N=100, r=0.3e-3)
```

You may find other variants of lenses in specific geometries, including a compound refractive lens (CRL) to enhance the focusing power, as more lenses focus closer. The **ZonePlate** is a set of concentric rings, very thin, that operate just as a Lens.

Some full usage examples are found in Tests_optics/Test_CRL, Tests/Be_BM_beamline and Templates/Focal_pt_monitor.

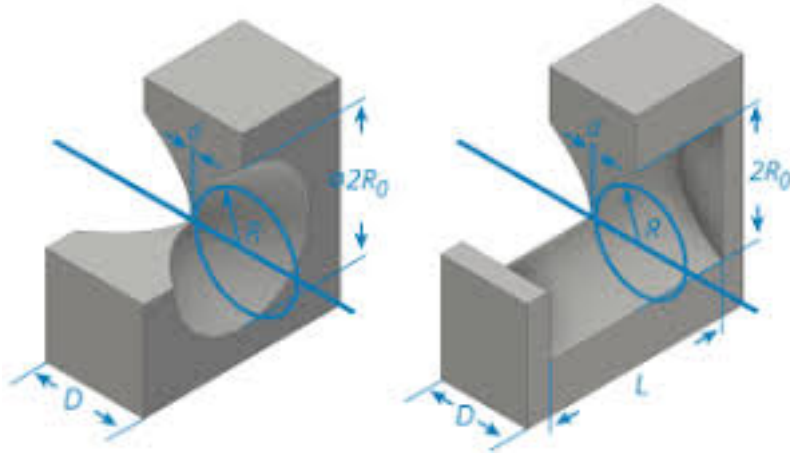


Figure 6: Lens

Grating_reflect (lamellar, blazed) Grating_trans

The gratings are periodic structures engraved on a material. They act as optical gratings, i.e. scatter the beam into quasi-monochromatic beams, each at different angle, following a rule similar to the Bragg law. They can also be used for phase retrieval at imaging/tomography stations to improve contrast.

`Grating_reflect(d_phi=1, order=0, rho_l=100, zdepth=102e-3, xwidth=102e-3)`

There are usage examples e.g in `Tests_optics/Test_grating_trans`, `Tests_optics/Test_grating_reflect`.

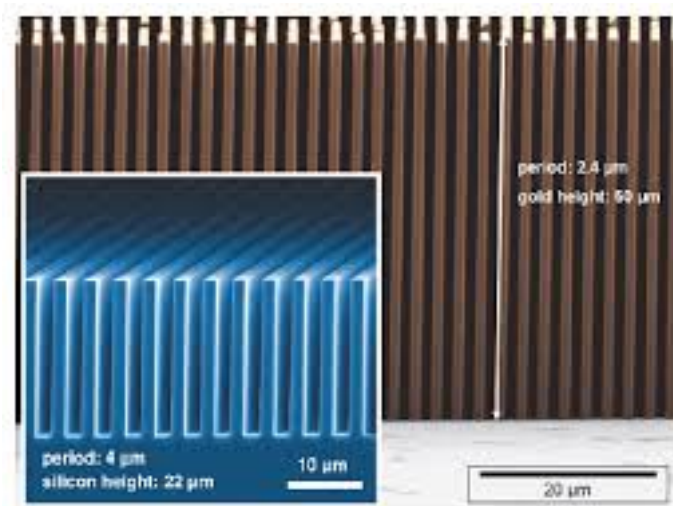


Figure 7: Gratings