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Multilayer Gratings – New Possibilities for Efficient, Flexible, Monochromators in the Tender X-ray range from 1.5 to 4 KeV

The higher and lower ends of the “Tender” X-ray region are not well defined in photon energy but the core of the range can be considered to be the point at which the two common X-ray monochromator types start to swap over; at present that swap over point is between 1.5 to 2 KeV. The two common monochromators are the double crystal monochromator (DCM) and the grating monochromator. The DCM relies on the availability of perfect single crystals cut to give diffracting planes with suitable lattice spacing such that a single photon energy is diffracted, with very high efficiency (60 to 90%) at angles between 3 to 80 degrees. For the lower photon energies the perfect single crystal has to work at very large angles close to normal incidence and at least for the first crystal generally has to absorb a very high power load without distorting or breaking down. For synchrotrons the only materials that work well in DCMs are semiconductor crystals, for silicon the lowest photon energy that could be monochromated is around 2 KeV. For grating monochromators they rely on the fact that X rays will reflect off a surface with efficiencies in the range 60 to 90%, if the X-ray angle of incidence to the surface is sufficiently shallow. The high reflectivity of the surface is a function of the photon energy, the angle of the surface and the total effective electron density of the material of the surface. To push towards higher photon energies the incidence angle of the surface has to be less than 2 degrees and the surface is generally coated with platinum, gold or rhodium. The monochromation is made by a single reflection grating that can have efficiencies in the range 30% at low photon energies to 5% above 2 KeV, Recently multilayers have been applied to gratings that can increase their total efficiency from 5% to over 50%. This allows grating monochromators to have efficiencies that are similar to DCMs and they become much more competitive in the range from 1.5 to 3 KeV, this could become the monochromator of choice in the range 2 to 3 KeV.

Keywords or phrases (comma separated)

Are you a student?

No

Do you wish to take part in the Student Poster Slam?

No

Are you an ECR? (<5 yrs since PhD/Masters)

No

What is your gender?

Male

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