Design and Performance of a Stable First Crystal Mount for a Cryogenically Cooled Si Monochromator at the APS

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Third generation sources such as the Advanced Photon Source (APS) provide X-ray beams with beam position stability on the order of ten microns. Typical optical elements and experimental set ups are respectively 30 and 60 meter from the source, thus to preserve the source position stability, a monochromator incident angle must be stable to within 10 micron/30m/2 ~ 0.2 microradians. Thermal drifts or unbalanced mechanical forces originating from cooling fluids can cause angular movements of several microradians, thus stable mechanical and thermally insulated mounts are essential to provide beam position stability.

At the University of Michigan, Howard University, Bell Laboratories-Lucent Technologies (MHATT) Insertion Device Beamline of the APS, we recently found out that the first crystal mount of our Si (111) cryogenically cooled monochromator was sensitive to the pressure fluctuations of the liquid nitrogen coolant. The angle of incidence on the first crystal varied linearly with the applied pressure in the cooling lines. Due to small time dependent fluctuations in the coolant pressure, we found that our monochromatic beam moved typically by about 100 micron, 60 m from the source. We have recently redesigned our first crystal mount in order to improve the beam stability. The first crystal is now held more firmly by the cooling manifold and forces caused by pressure variations in the cooling lines have been carefully balanced and minimized. In our presentation, we will describe the new mount design, and report on the significant improvement in beam stability provided by this mount.

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