Contribution ID: **19** Type: **not specified**

Mechatronic Design Principles applied to a DC Monochromator to reach 10 nrad Crystal to Crystal Stability.

Tuesday, 21 March 2017 08:55 (25 minutes)

For the Sirius, Brazilia's 4th generation light source under development by LNLS, a novel Double Cristal Monochromator (DCM) is developed. The monochromator is known as one of the most critical optical elements in a beamline. The new 4th generation light source, with an emittance in the range of 100 prad, requires extreme stability performance, requiring a crystal to crystal stability in the order of 10 nrad. To reach these tight numbers, even during Bragg angle motions for fly-scan operation, a novel design is required, which is based on active positioning control of the second crystal towards the first.
Using mechatronic design principles with proper dynamic architecture enables very high dynamic disturbance reaction, as MI-Partners commonly uses in high-end semiconductor production equipment like wafer scanners, die-bonders and electron microscopes. In the DCM, under manufacturing now, a close loop bandwidth can be reached in the order of 300 Hz, giving a few nrad positioning error between both crystals. The dynamic architecture is based on zero stiffness actuators (voice coils) and the use of a balance mass, long-stroke/short-stroke principle
Furthermore, the design aims for extreme high thermal stability. Measures like separating structural and metrology loops enables the use of materials like invar for the metrology frames and aluminum for the structural loops, giving both optimal thermal performance and dynamic performance. To minimize the heat leakage of the liquid nitrogen cooled parts and minimize deformations of critical elements like crystals and metrology frame while achieving a high critical internal eigenfrequency above 1000 Hz, proper suspension by elastic elements are applied. For further improvement of the thermal stability, active temperature control is implemented to all critical elements.
To minimize one of the main vibration sources, flow of liquid nitrogen for cooling of crystals, design principles are applied as MI-Partners commonly uses in high-end systems like wafer-stages and TEM (Transmission Electron Microscopes). By making use of these principles, vibrations are cancelled out and noise sources are minimized. Measurements have be done by LNLS and show the positive effect of these principles.

Presenter: Dr RUIJL, Theo (MI-Partners)

Session Classification: High-precision Engineering