New High-Heat-Load Beamline Components for the ESRF

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Abstract

Third-generation synchrotron light sources generate small and intense photon beams, of typically a few mm cross section and several 100 W/mm^2. This induces severe thermal constraints on the beamline components defining the beam size (slits) and filtering the beam (attenuators), and on beryllium windows. At the ESRF, the installation of small-gap undulators (in vacuum undulators, 11-mm gap in air undulators) has drastically increased the beam power density. The maximum power density at 27 m from the source has increased from 230 W/mm^2 to 400 W/mm^2 and could reach 720 W/mm^2 in the future. It was therefore decided to develop new primary slits and new attenuators, and to check the heat load acceptable by beryllium windows.

High power (HP) primary slits have been designed. The principle is based on the idea of the L5-92 slits designed by D. Shu at APS: Two water-cooled blocks with square apertures are moved in Y and Z by external translation stages. The main characteristics of the HP slits are: Beam size: 0 to 4 mm; Accuracy: 20 microns; Power density: 400 W/mm^2 (design value); Total length: 740 mm. Three of these slits are in operation and another five are being manufactured.

New attenuators are being developed. The purpose of the attenuators is to absorb the low-energy rays of the beam in order to reduce the heat load on the optical components. The HP attenuators use CVD diamond (thickness 400 to 1200 microns) as a filtering element. CVD diamonds offer extremely high thermal conductivity and relatively low volume X-ray absorption, which should enable it to absorb 50 W/mm^2 without thermal problems. The behavior of the water-cooled beryllium windows has also been studied.

Keywords: high heat load, primary slits, attenuators, beryllium windows

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