LATEST DEVELOPMENTS OF ADVANCED X-RAY OPTICS AND THEIR APPLICATIONS IN X-RAY MICROANALYSIS

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Both polycapillary X-ray optics and doubly curved crystal (DC) optics have undergone significant development in the past years, and the technologies have been widely used in X-ray analytical instruments and a variety of research applications. This paper will review the applications of those optics in microanalysis and repor some of the latest optic development work that aims at enhancing optic performance and extending the capability of the technologies.

A polycapillary X-ray optic is a broad-band optic that collects a large solid angle of X-rays from a divergent X-ray source and converts then to either a parallel beam or a focused beam. The optic consists of up to millions of small channels that are precisely curved to a designed profile to efficiently transmit X-rays by multiple external total reflections off the inner surface of each individual capillary channel. A doubly curved crystal (DCC) optic, on the other hand, is a diffractive X-ray optic that collects X-rays from a divergent X-ray source and redirects a narrow band of them by diffraction. By bending a crystal in two dimensions one can achieve point-to-point focusing from a microfocus X-ray source and therefore obtain a focused, monochromatic beam. The two optic technologies have their own characteristics and advantages. But they are also complementary technologies, so one can choose one or another or combined for specific applications. Experimental results of the state-of-the-art performance of the optics will be presented and reviewed in this paper. Application examples will be given to demonstrate the benefits of using each type of the optic or combining the two types of optics in meeting specific application requirements.