DUAL-CAPILLARY OPTIC MXRF

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Polycapillary optics have been used for a number of years in spatially shaping X-ray beams for excitation. They provide spot sizes of 50 micrometers or more and focus X-rays by using total external reflection within a bundle of glass capillaries. The unique feature of these X-ray optics is that they provide a substantial increase in X-ray flux at the specimen surface. In some cases a factor of 1000 times' greater intensity than can be achieved with a polycapillary optic over an aperture. The focusing nature of the polycapillary can be used on the detection side to increase the sensitivity and spatial resolution. This is achieved by overlapping the focal spots of two polycapillaries, one on the excitation side and one on the detection side.

The analytical utility of using a dual-capillary optic system is demonstrated in analyzing a radioactive specimen. Typically the radiation background of even low level specimens creates both qualitative and quantitative problems. In some cases the radiation is so high that the detector can be saturated and prevent any analysis from being done.

A proof-of-principle experiment was done using an iron 55 source. The radiation background from an iron 55 source prevents any analysis of the manganese content of the source and creates a substantial background signal which compromises the detection sensitivity. The overlapping of the two focal spots of two polycapillaries provides a discrete area of analysis where only emitted X-rays along the axis of the polycapillary optic will be detected. The overall result from integrating polycapillary optics on both the excitation and detection sides of an MXRF system is an enhanced spatial resolution and lowered background. This is particularly important when analyzing a radioactive specimen. Our results on this demonstration system show that the radiation background can be almost eliminated from the spectrum. This opens new application opportunities for MXRF analysis of radioactive specimens.