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Two-axis goniometer for reflectivity measurements of x-ray diffractors used in fusion research (abstract)\(^a\)

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Quantitative measurements of the line and continua emissivities and the analyses of spectral line profiles are essential steps in the interpretation of the x-ray emission from high-temperature fusion plasmas. One method of placing the emissivities on an absolute basis is to use an absolutely calibrated spectrometer to record the data. The overall sensitivity of the spectrometer can be constructed in terms of the efficiencies of its separate components, the most intractable being \( R_c \), the reflection integral of the diffractor. To this end, a new, compact, two-axis diffractometer, incorporating modern robotic technology, such as direct-drive servomotors with closed-loop operation from built-in arcsec optical encoders, has been constructed. Improved features of this double-axis goniometer include the use of fixed line-of-sight x-ray sources with the capability of operation in the \((l, -l)\) parallel, nondispersive mode or the antiparallel, \((l, +l)\), dispersive mode. The diffractometer is now being used to calibrate x-ray diffractors, filters, mirrors, and detectors associated with x-ray spectroscopy of fusion plasmas. At certain wavelengths, where line branching ratios involving visible transitions are available, the fusion plasma may itself be used as a transfer standard of x-ray luminosity, allowing an independent check on the diffractometer values of \( R_c \). Applications to the analyses of impurity concentrations in tokamaks are described while future applications of the diffractometer to radiation damage studies of x-ray and optical components [Hill \textit{et al.}, Rev. Sci. Instrum. 63, 5032 (1992)] used in D-T burning plasma experiments are envisaged.

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