Applications of a new spectroscopic technique for the study of interactions of synchrotron radiation with multicharged ions and gaseous targets in the extreme ultraviolet (EUV), soft x-ray (SXR) and x-ray regions

Reinhard F. Bruch, Victor L. Kantsyrev, V. Golovkina, A. Shylaptseva, and I. Golovkin
Physics Department, University of Nevada, Reno, Reno, NV 89557, U.S.A.

D. Schneider
N-division, Lawrence Livermore National Laboratory, Livermore, CA 94450, U.S.A.

In synchrotron radiation experiments with atomic, molecular, laser-excited, aligned or oriented targets, and multicharged ion beams, we are challenged with the detection of weak fluorescence signals in the EUV, SXR or x-ray wavelength range. Recently we have developed new optical devices based on glass capillary converters (GCC) [1-3] for studies of fundamental collision processes with synchrotron radiation and highly charged ion-atom collisions. As a pilot project, we have built a unique guiding and focusing device that has been tested in conjunction with a high resolution 2.2 m grazing incidence monochromator to record EUV spectra (λ<600Å) following Ar^{8+}+He, O^{6+}+He, N^{5+}+He, and He^{2+}+He single collisions [2]. We have achieved a coefficient of intensity enhancement of radiation on the entrance slit of the monochromator ranging from 10 to 30, depending on the design of the target area. In particular we have focused radiation from a cylindrical ion beam segment over a distance of about 60 cm with a 90° rotation of the image. Due to the substantial enhancement of intensity of short wavelength radiation achieved, we have been able to detect numerous weak spectral lines in the EUV region. This new spectroscopic method has huge potential for more detailed studies of synchrotron radiation beams interacting with gaseous and surface targets as well as highly charged ion beams not only in the EUV but also in the SXR and x-ray regions.

This work has been supported by the NAS/CAST Program, ACSPECT Corp., Reno, Nevada and in part by LLNL and AVS.

[1] V. Kantsyrev et al., Appl. Phys. Lett. 66, 3567 (1995).
[2] V. Kantsyrev, R. Brunch, Rev. Sci. Inst. 68 (1997) to be published
[3] R. Brunch et al., Rev. Sci. Inst. 68, (1997) to be published