Comparison of the Methods for the Background Reduction of Thick Targets in Routine PIXE Analysis

VI. 6 Comparison of the Methods for the Background Reduction of Thick Targets in Routine PIXE Analysis

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In the case of analysis of insulating materials using PIXE method, high background due to charging-up effect is observed at higher energy region of X-ray spectrum. This phenomenon is observed apparently when the thick insulating materials such as Micropore filter and filter paper of thickness more than 10 μm are used those are inavoidable filters in chemical analysis. To increase the applicability of PIXE analysis for many forms of target, it is necessary to reduce the background due to charging-up on a thick insulating target.

In this paper we showed method which make it possible to apply routine analysis of insulating materials, e.g. rock and glass sample, and which enhances the sensitivity.

Many authors reported on the reduction of background due to the charging-up effect, for example; 1) release the charge using the conducting materials, 2) horseshoe magnet method, 3) electron-gun method, 4) bombard at atmosphere or inert gas, whose comparison in detail is to be found eleswhere.[1] Among those methods we adopt the method that the surface of insulating target, glass is coated with thin carbon film as conducting material, because this method required no special consideration on chamber.

NBS-SRM 612 Glass was employed as target, which contained the 61 elements of the concentration about 50 ppm in the glass matrix, (id. 10 mm, thickness 3 mm). 4 MeV proton from 40 MV AVF cyclotron, Tohoku University Cyclotron Radioisotope Center, was used as a bombardment particle and 110 μm Mylar film with 50 μm aluminium foil was inserted in front of Si(Li) detector as the absorber of Rutherford scattered proton and low energy of X-rays. Carbon film (32 $\mu g/cn^2$, Arisona Carbon Foil Co.) was used since they have a low absorption coefficient for X-ray.

The X-ray spectra obtained from NBS glass coated with and without carbon film are shown in Fig. 1. The analytical results accompanied with NBS certified values are shown in Table 1, which were obtained from the analysis of X-ray spectrum using FORTX-81 program. Fig. 1 and Table 1 accompany the result from the carbon filter method which was developed by Oona.[2]

The standard deviations listed in Table 1 are the statistical error which were calculated from the background. The standard deviations obtained from glass coated with carbon film are one-half of that without carbon film, and clearly small compared to that of the carbon filter method. It means that to coating the surface the sample with carbon film results the enhancement of sensitivity in quantitative analysis of PIXE for the thick insulating sample.

The variation of this method may reduce the background of the filter papers due to the charging-up effect.

References

1) Shiokawa T. and Izawa G., Kagaku, 35(4) (1980) 321.
2) Oona H., Kirchhner S. J., Kresan P. L., Fernando Q. and Zeilin H., Anal. Chem., 51, (1979) 302.

Table 1. The Analytical Results of NBS-SRM 612 Glass with and without Carbon Film and Carbon Filter Method.

Element	Coated with carbon film	Without coating	Carbon filter method	NBS certified value
Cr	26 ± 13	14 ± 20	16 ± 17	39.6 ± 0.8
Mn	31 ± 9	33 ± 14	17 ± 12	39.6 ± 0.8
Fe*	51	51	51	51 ± 2
Co	20 ± 6	20 ± 9	28 ± 8	35.5 ± 1.2
Ni	33 ± 6	36 ± 9	38 ± 8	38.8 ± 0.8
Cu	41 ± 6	43 ± 8	45 ± 8	37.7 ± 0.9
Ga	39 ± 6	49 ± 10	43 ± 9	-
As	49 ± 7	59 ± 13	36 ± 11	-
Se	14 ± 6	7 ± 13	9 ± 11	-
Rb	51 ± 7	43 ± 15	48 ± 11	31.4 ± 0.4
Sr	77 ± 5	96 ± 14	103 ± 9	78.4 ± 0.08
Y	38 ± 55	43 ± 14	40 ± 8	-
Zr	27 ± 6	28 ± 14	33 ± 8	-
Nb	32 ± 6	39 ± 13	27 ± 7	-
Mo	20 ± 5	25 ± 13	24 ± 7	-

*Fe 51 ppm was used as standard.

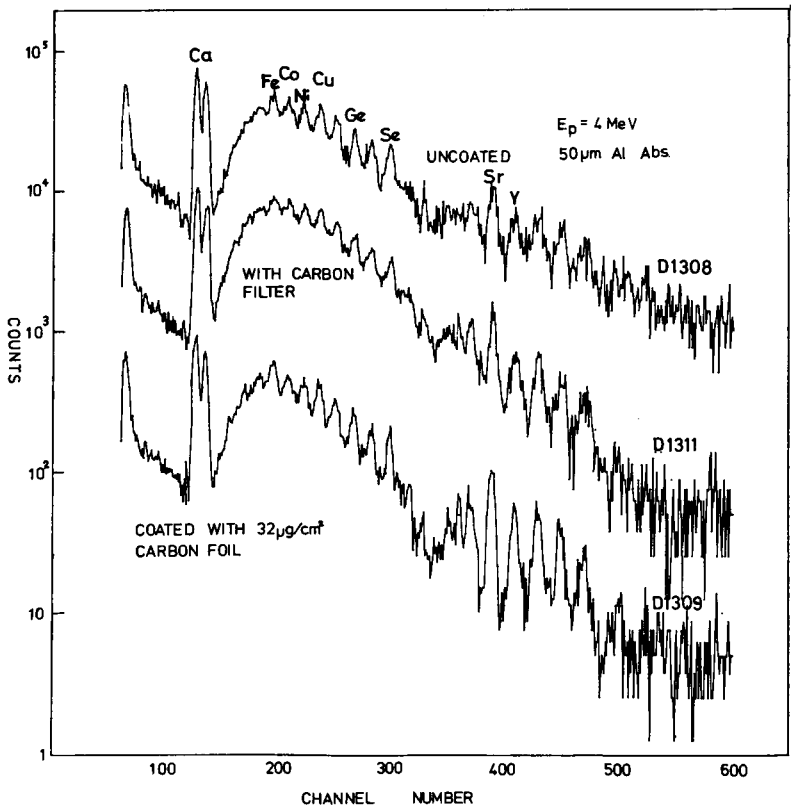

Fig. 1. The X-ray spectra of NBS-SRM 612 glass.