APPLICATION OF DICESIUM METABORATE ION FOR THE DETERMINATION OF BORON BY THERMAL IONISATION MASS SPECTROMETRY


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Application of dicesium metaborate ion /Cs$_2$BO$_7^+$/ in Thermal Ionisation Mass Spectrometry /TIMS/ for the determination of boron present at sub ppm level in heavy water moderator as well as for the isotopic composition of boron in boron carbide is reported. Contamination of samples with natural boron while determining trace levels of boron in heavy water was checked by analysing SRM-952 isotopic reference material. The atom ratios of boron in B$_4$C were determined by directly fusing the material on the tantalum filament with Cs$_2$CO$_3$ as well as with Na$_2$CO$_3$ and also by following the conventional fusion procedures and the results were compared.

INTRODUCTION

Boron is an important material in nuclear technology as one of its isotopes /$^{10}$B/ has large thermal neutron absorption cross section of about 3837 barns.
Consequently boron at ppm level is used as burnable poison in the form of a homogeneous solution of $\text{H}_3\text{BO}_3$ in heavy water moderator systems of a nuclear reactor to control the reactivity. In larger amounts it is used as $\text{B}_4\text{C}$ in the control rods of the reactor. The extent of reactivity control critically depends on the absolute amount of $^{10}\text{B}$ and hence it is essential to determine the concentration and isotopic composition of boron with high precision and accuracy. Even though $\text{Na}_2\text{BO}_2^+$ ion technique is widely employed for the determination of boron; recent investigations carried out in our laboratory have resulted in the development of a method for the determination of isotopic composition of boron by analysing boron as $\text{Cs}_2\text{BO}_2^+$. This method was shown to be superior to the $\text{Na}_2\text{BO}_2^+$ ion analysis method in terms of flexibility in keeping Cs/B atom ratio, negligible isotopic fractionation and simple loading techniques. Recently this method has been applied to analyse aqueous and solid-phase samples of geological interest. This paper describes the application of this technique in nuclear technology for the analysis of boron in heavy water and $\text{B}_4\text{C}$ samples.

EXPERIMENTAL

Instrument

The instrument is a first order, direction focusing model Mat-261 thermal ionisation mass spectrometer operating at a nominal resolving power of 450. All the operations are controlled by an on-line Hp-9835 A desk-top computer. Faraday cup as well as Secondary