Determination of Boron and Other Traces in Steels by Laser Ablation ICP-MS

Laser Ablation ICP-MS with the CETAC LSX-100

Problem: The determination of trace levels of boron is often hampered by the element's complex chemistry when the sample is to be digested. However even when the sample is to be determined by direct solid sampling techniques, there may also be problems associated with the volatility of the element which can often result in spurious calibration functions.

Solution*:* The CETAC LSX-100 UV laser ablation system affords a more controlled ablation process and removal of analyte from the sample thus minimizing the complex thermal effects often associated with more vigorous solid sampling techniques.

Advantages:
- UV ablation ensuring controlled coupling to all materials.
- TEM_{00} mode of operation giving true Gaussian beam profiles.
- Compatible with all ICP-MS systems.
- Excellent signal stability.

Analytes*:* Boron and other trace elements in National Institute of Standards and Technology (NIST) series standard steels.

Results: A series of steel standards from NIST was analyzed by laser ablation ICP-MS using the CETAC LSX-100 laser sampling system. Calibrations derived from each standard were then used to further quantify a wide range of trace elements at ppm levels in the steels. Table 1 illustrates the accuracy obtained for these elements and seen to be generally within the accepted ranges. Of particular note is the determination of boron, traditionally a difficult element because of its complex chemistry and also its volatility. Boron was able to be determined in the same suite as the other elements without any further specific system optimization. A linear calibration for boron is shown on Figure 1., and precision, better than 2.2% over five separate replicates was obtained even at the lower end of the calibration range.

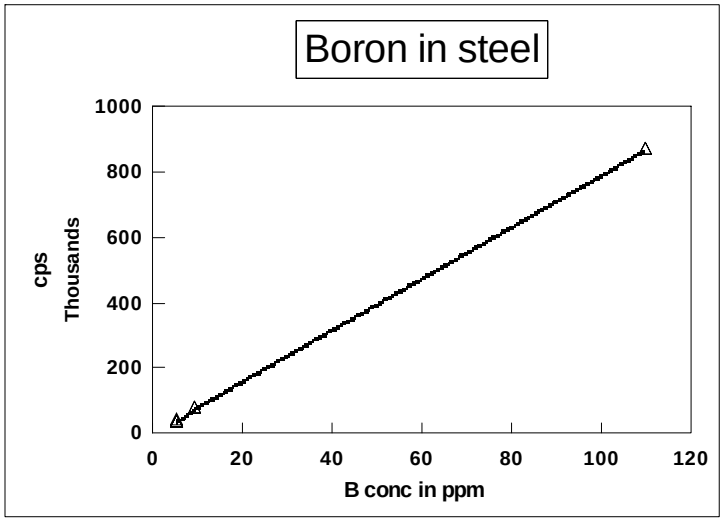

Figure 1. Calibration function for boron in NIST steels using the CETAC LSX-100 laser sampling system.

Conclusions: The controlled UV ablation afforded by the CETAC LSX 100 laser ablation sampling system allows difficult elements such as boron to be determined directly in metallurgical samples. Previously reported difficulties due to the volatility of Boron are eliminated using this system and the precision of the measurements is typically at the 2 % level even at low ppm boron concentrations. The capability to determine other elements in the same analytical sequence is also clearly an advantage and the correlation for a further 16 elements demonstrates the practicality this approach.

Element	**NIST 1261**		**NIST 1263**		**NIST 1264**	
	Determined	**Cert**	**Determined**	**Cert**	**Determined**	**Cert**
B	6	6	8	9	112	118
Mg	1.8	1.8	3.8	4.9	1.2	1.5
Al	200	210				
P	160	160	300	290	110	100
Ti	190	200	460	500	2,300	2,400
V	110	110	2,800	3,100	1,000	1,060
Cr	6,800	6,930	13,000	13,100	640	660
Mn	6,600	6,700	-	-	2,000	2,560
Nb	210	220	420	490	1,800	1,570
Mo	1,800	1,900	280	300	4,200	4,900
Sn	100	100	1,000	1,040	67	80
Sb	42	42	16	20	230	340
Ta	200	210	810	-	960	-
W	160	170	410	460	980	1,020

Table 1. Quantitative data for trace elements at ppm levels in NIST steel reference standards.