



ICP-Mass Spectrometry

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The Advantages of the NexION 300D ICP-MS for the Determination of Titanium in Serum

Introduction

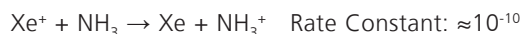
Titanium (Ti) is commonly used in metallic hip replacement joints. Owing to wear and tear or different types of electrochemical processes that could take place in

the body, there is a serious potential of leakage of Ti into the surrounding tissues. As such, it is important to monitor the Ti serum levels in patients that have undergone or are due to undergo a hip replacement surgery. The analysis of Ti in serum by inductively coupled plasma mass spectrometry (ICP-MS) faces many challenges due to significant spectroscopic interferences from Ca on the major isotope of Ti (m/z 48) and other molecular ions such as PO^+ , SO^+ , CO_2^+ , ArC^+ and NO_2^+ .

The PerkinElmer NexION® 300D ICP-MS is a robust, highly innovative cell-based system benefitting from three quadrupoles with the middle one acting as a universal cell. This cell can be used both as a collision cell using inert gases, such as He, and as a true dynamic reaction cell with the benefits of using the most appropriate reactive gas for the efficient targeting of any spectral interference. In this work, we describe a method to shift the Ti ions away from the interferences using Reaction mode with ammonia as the reaction gas to determine the concentration of Ti in serum.

Analytical methodology

Figure 1 shows a scan for 10 ppb Ti in Reaction mode (NH_3 gas flow 0.9 mL/min, rpq 0.2) at m/z 129-134. The m/z of the observed peak suggest that the Ti complex observed is $\text{TiNH}(\text{NH}_3)_4^+$, as evidenced by the peaks reflecting the Ti isotopic abundance. The formation of this complex was stable and reproducible. Figure 2 shows a calibration curve for Ti at mass 131. Although Xe^+ has an isotope at m/z 131, it will not interfere with the Ti measurements since Xe reacts rapidly with NH_3 :



Using matrix-matched calibration, Ti was measured in a SeronormTM Trace Elements Serum L-1 reference material (LOT0903106) diluted 10x with 0.1% HNO_3 . The results obtained (10.6 ± 0.3 ng/mL) compared favorably with the recommended value for Ti in this sample (11.2 ng/mL).

In order to gauge the detection capability of the method, 10 repeat analyses of a blank containing 10 ppm Ca (in order to simulate the Ca levels in 10x diluted serum) were performed. The observed concentration in the matrix was 0.031 ± 0.00122 ng/mL. This data suggests a detection limit (3 sigma) of 0.004 ng/mL in solution (0.04 ng/mL in serum) and a limit of quantification (10 sigma) of 0.0122 ng/mL in solution (0.12 ng/mL in serum).

Summary

This application brief highlights the potential of the NexION 300D ICP-MS for the analysis of Ti in serum. Using NH_3 in Reaction mode, we successfully overcame the variety of interferences from serum on Ti. As a result, we were able to determine the levels of Ti in serum both accurately and reproducibly.

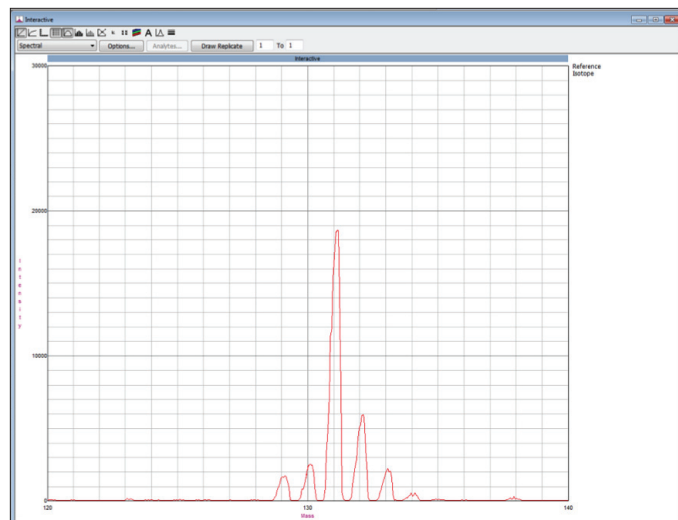


Figure 1. Spectrum for 10 ppb Ti in Reaction mode.

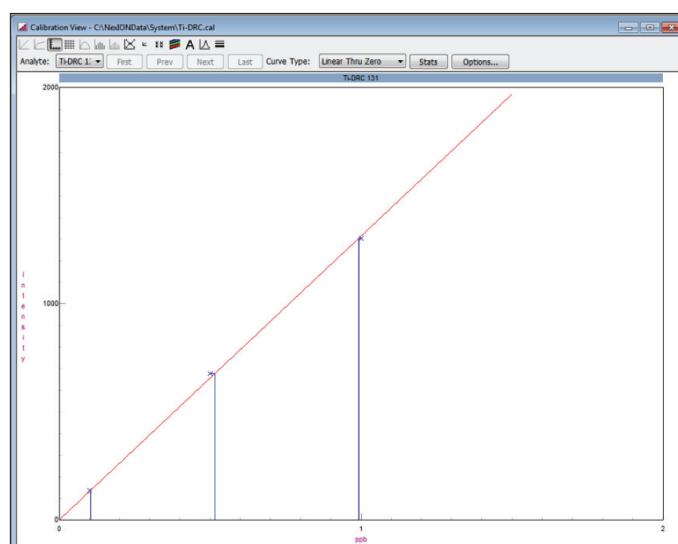


Figure 2. Calibration for Ti in Reaction mode.