Introduction

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 (NH₃ 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 TiNH(NH₃)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 NH₃:

\[ \text{Xe}^+ + \text{NH}_3 \rightarrow \text{Xe} + \text{NH}_3^+ \]  
Rate Constant: \( \approx 10^{-10} \)

Using matrix-matched calibration, Ti was measured in a Seronorm™ Trace Elements Serum L-1 reference material (LOT0903106) diluted 10x with 0.1% HNO₃. 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 for non-clinical applications. Using NH₃ 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.

For research use only. Not intended for diagnostic procedures.