ICP-MS applications

Inductively Coupled plasma-mass spectrometry (ICP-MS) is a multi-element technique that uses plasma to disassociate the ions contained in a sample. Ions are extracted from the plasma and passed through a mass spectrometer for detection based on mass to charge ratio. ICP-MS is a highly sophisticated analytical technique that is capable of sub-ppt (parts per trillion) detection limits. The lowest detection levels can only be achieved in a clean room environment.

With ICP-MS and many other methods, reagent water is used to create instrument blanks, calibration curves and sample dilutions. To make calibration curves, the analyst takes a known concentration of single or multiple elements or compounds and dilutes them to form a working range of standards. These standards are injected into the instrument with an instrument blank (zero) to provide a calibration curve. Once the instrument has been calibrated, unknown samples are injected into the instrument to determine how much of a given analyte may be present. That is, the concentration of the unknown should fall somewhere in the standard curve. If an unknown sample has a higher concentration of analyte than the standard curve allows, than the sample may have to be diluted to bring it into range.

ICP-MS is an important analytical technique for the pharmaceutical, food and beverage and environmental industries. The technique has a high productivity rate and allows for multi-element detection from a single sample. ICP-MS is susceptible to spectral interference from ions having the same mass to charge ratio. For example, nitrogen in the form of N_2 can interfere with silicon analyses due to the same mass to charge ratio of 28. This is called an isobaric interference and should be considered relative to type of sample and sample preparation chemistries.

Other forms of interference have been discussed that are important to ICP-MS techniques. One of these involves the analysis of ultrapure or reagent grade water used in the laboratory. To start, if Type 1 reagent grade water is to be analyzed, the lowest level detection is assumed based on the purity of the sample. Therefore, a clean room environment is a necessity for this type of work. Second, the reagent grade water should be collected immediately prior to analysis in a clean, well-rinsed plastic container to prevent contamination from the container. It should also be noted that purified water would absorb a significant amount of carbon dioxide from the atmosphere as soon as it is exposed. There is a possibility that the carbon dioxide could cause isobaric interference of calcium.

The most common interference reported by ICP-MS users relates to boron and silicone showing up in samples. In all cases reported to date, this has been from new systems recently installed. The lab analyst may see what he believes to be contamination coming from the water system. The source of the contamination has always been traced to borosilicate glass used for sample handling. It has also been traced to borosilicate glass used in the internal and external sample handling equipment of the ICP instrument. The best way to eliminate this is to perform multiple injections of the same sample into the instrument. This will clean the surface contamination off the wetted parts of the new ICP-MS.

Another type of contamination has also been traced to the auto sampling equipment and sample carrying hardware of the instrument. Many laboratories run relatively dirty samples on ICP-MS instruments. Residue from samples can deposit in pickup tubes and instrument sample plumbing equipment. As the reagent water is injected into the system, this residue is cleaned from the inside surface of the tubing and other sample handling equipment and appears to be coming from the water sample. This is called sample carryover and can occur with any method that uses automatic sample handling equipment. Reagent water is very aggressive and will actively clean these surfaces. Again, the best way to eliminate this type of interference is to make multiple injections of one or more reagent water samples. This will typically show a trend of lower and lower levels of the ionic impurities until eliminated.

Finally, when performing ICP-MS analysis or any low level analytical work, it is always a good idea to rinse 50 to 100 ml of water to drain from the reagent grade water system final filter before collecting the water. This eliminates any contamination that may have accumulated in the holdup volume of the filter.

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W/sart-000 · G
Publication No.: SLG2016-e01041
Order No.: 85030-514-80