

Ultra-trace Detection of Metal Carbonyl Impurities in Syngas and Carbon Monoxide

Carbon monoxide (CO) is used in a number of industries and applications. However, carbon monoxide can form a metal carbonyl on contact with metals such as chromium, molybdenum, iron, nickel, and cobalt. Because of this characteristic, it is important that the concentration of metal carbonyls in carbon monoxide or gas mixtures containing carbon monoxide is known or controlled.

CONSCI's Carbonyl Impurity Analysis harnesses the technique of gas chromatography-inductively coupled plasma-mass spectrometry (GC-ICP-MS) to separate and quantitate ultra-trace levels of volatile metallic and organo-metallic compounds. GC-ICP-MS is particularly well suited to this application because of its sensitivity as well as its selectivity and tolerance of significant levels of other components in the sample matrix.

Earlier methods in this measurement yield highly suspect results. CONSCI has developed and published innovative sampling and analytical technology to address these shortcomings and has

established a novel calibration technique required for analytes for which gas phase standards are not available.¹

This technique accurately and quickly reaches detection limits well below industry standards. Measurement of levels as low as parts-per-trillion are easily achievable.

In Figure 1, part-per-billion level impurities of nickel, iron, and chromium carbonyls can be measured in a single analysis, however, when analyzed separately as in Figure 2, detection limits of 50 parts-per-trillion are achieved!

| | Calculated (ppb) | Actual (ppb) |
|------------------|------------------|--------------|
| ⁵⁰ Cr | 4.35 | 3.91 |
| ⁵² Cr | 83.79 | 83.09 |
| ⁵³ Cr | 9.50 | 10.23 |
| ⁵⁴ Cr | 2.37 | 2.78 |

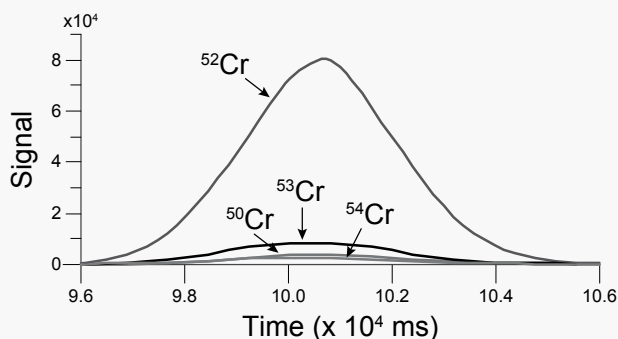


Figure 2. Isotopic measurement/confirmation of chromium carbonyl at ppt levels with calculated and actual amounts.

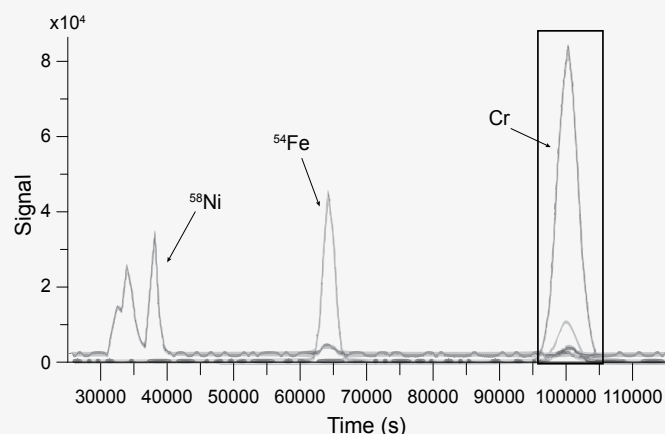


Figure 1. Chromatogram of nickel, iron, and chromium carbonyls at ppb levels in a single analysis.

¹ Geiger, W. M., McSheehy, S., & Nash, M. J. (2010). Application of ICP-MS as a multi-element detector for sulfur and metal hydride impurities in hydrocarbon matrices. *Journal of Chromatographic Science*, 45, 10, 677-682.

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