Enhancing Analytical Expertise and Benchmarking for High Purity Alumina

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# ABSTRACT

The growing demand for high purity alumina (HPA: >99.99% Al2O3) in various applications, such as electric vehicle batteries and LED production, necessitates a comprehensive understanding of the impurities present in HPA and their impact on different end uses. From a desktop study, battery separators are concerned with impurities such as Si, Na, Ca, Fe, Cu, and Mg and appear to be limited to ≤10 mg/kg to maintain electrical insulation and prevent short-circuiting. On the other hand, LEDs require different impurity profiles, with Ti, Cr, Si, Ca, and Mg potentially included depending on the desired sapphire crystal properties. For achieving a bright white LED, specific limits are set for Cr, Mn, Zn, Pb, and Ni (≤1 mg/kg). This research has benchmarked commercially available HPA based on the type of impurities and to what level of impurity to gain insights into the specific requirements of customers and markets.

This research has also focussed on building confidence in analytical methods in terms of the type of analysis method that should be used depending on the target purity level and contaminates (4N: 99.99% vs 5N: 99.999%). This has arisen as there are no standards in the analysis of HPA or the emerging high purity battery materials. Whilst there are numerous techniques to analyse the elemental composition of a sample, ICP-MS and ICP-OES are the most common, largely due to their ability to achieve multi elemental analysis, and high sensitivity. However, another technique that is used, particularly for the analysis of high purity metals is glow discharge mass spectrometry (GD-MS) and has been adopted by industry as a technique for HPA. This study will highlight the pros and cons of each method both from a theoretical and experimental standpoint, which will inform the development of analytical expertise in the context of high purity critical minerals.