

Advances in Instrumentation Techniques for Analysis of Energy Storage Materials: Expanding Capabilities Using Hyphenated Technologies

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The characterization of advanced materials and complex formulations presents unique analytical challenges, which are often difficult to address using traditional instrumental approaches. Evolved gas analysis using hyphenation technology is rapidly emerging as a powerful technique for in-depth material characterization by coupling two or more types of analytical instruments to qualitatively and quantitatively study material chemistry and the nature of gases evolved during decomposition. Such an approach allows greater compositional insights and complements the quality of information which would previously not be observed by either instrument on their own. In this talk, we will learn about Hyphenation Technology, and consider their applications in energy storage materials including solid-state batteries. In the first case study, we will demonstrate the use of thermogravimetric analysis-infrared spectroscopy-gas chromatography-mass spectrometry (TG-IR-GC/MS) in the degradation analysis of a solid polymer electrolyte. TG-IR-~~GC/MS~~ mass is a general term given to the mixture produced in battery recycling, specifically the

pyrometallurgical process. One of the key early steps in battery recycling is driving off remaining liquid electrolyte by heating the shredded components. Thermogravimetric analysis coupled to infrared spectroscopy (TG-IR) provides a technique with which the residual electrolyte may be quantified, using TGA, then identified by measuring the IR spectrum of the evolved gases.