



Application Note AN-V-239

Iron speciation in LiFePO_4 batteries

Simultaneous determination of Fe(II) and Fe(III) in lithium iron phosphate with the Multi-Mode Electrode pro

Lithium iron phosphate (also known as LiFePO_4 or lfp) batteries last for over 2000 charges and are safer because of their lower risk of overheating. LiFePO_4 batteries have a slightly lower energy density compared to lithium-ion batteries. However, high discharge rates of lfp batteries make them ideal for electric vehicles, renewable energy storage, and backup power systems. Lithium iron(II) phosphate is used as a cathode material in lithium iron phosphate batteries. Characterization of lfp and monitoring the oxidation state of iron in lfp batteries is relevant to battery performance in terms of durability, capacity,

and safety. Additionally, analyzing chemical composition can be useful for battery research and can aid eco-friendly recycling practices. This is essential for driving battery technology forward and promoting clean energy solutions.

Polarographic speciation of Fe(II) and Fe(III) can be used to evaluate the purity of LiFePO_4 and its usability as a cathode material in lithium iron phosphate batteries. It can further be used to study the concentrations of Fe(II) and Fe(III) in the cathode material after several charging and discharging cycles to evaluate the aging behavior.

SAMPLE

Pure LiFePO_4

EXPERIMENTAL

The lfp sample is weighed, mixed with degassed diluted sulfuric acid, heated at 85 °C for 15 minutes, and then cooled. Afterward, the digested sample solution is added to the measuring vessel that contains 20 mL degassed electrolyte. Quantification is done using two standard additions with separate Fe(II) and Fe(III) solutions.



Figure 1. 884 Professional VA manual for MME.

Table 1. Parameters

Parameter	Setting
Mode	DME
Start potential	0.0 V
End potential	-1.5 V
Sweep rate	30 mV/s
Peak potential Fe(II)	-0.25 V
Peak potential Fe(III)	-0.8 V

ELECTRODES

- Multi-Mode Electrode pro

RESULTS

The viva software delivers unmatched versatility and flexibility by automating data conversion and displaying data in different formats to save time and reduce the risk of errors. **Table 2** shows how viva effortlessly translates concentrations from g/L to mg/g of tested material, enhancing understanding of the results for inexperienced users.

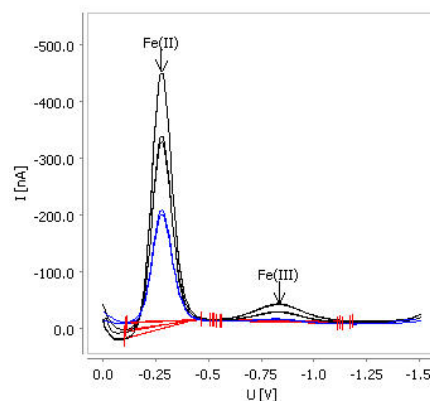


Figure 2. Determination of Fe(II) and Fe(III) in digested lithium iron phosphate with the Multi-Mode Electrode pro.

Table 2. Result

Sample	Fe(II) (g/L)	Fe(III) (g/L)
Digested LiFePO_4	2.8	0.09

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Sample	Fe(II) (g/L)	Fe(III) (g/L)
Digested LiFePO_4	2.8	0.09
Sample	Fe(II) (mg/g)	Fe(III) (mg/g)
LiFePO_4	350	11

CONTACT

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CONFIGURATION



884 Professional VA manual per l'elettrodo Multi-Mode (MME)

L'884 Professional VA manual per l'elettrodo Multi-Mode (MME) è il modello base per la analisi delle tracce di fascia alta con voltammetria e polarografia con l'elettrodo Multi-Mode, l'elettrodo scTRACE Gold o l'elettrodo a goccia di bismuto. La comprovata tecnologia degli elettrodi Metrohm, in combinazione con un potenziostato/galvanostato potente e il software viva estremamente flessibile, apre nuove prospettive per la determinazione dei metalli pesanti. Il potenziostato con calibratore certificato si regola automaticamente prima di ogni misurazione e garantisce la massima precisione possibile.

Con lo strumento possono essere eseguite anche determinazioni con elettrodi a disco rotante, per esempio determinazioni di additivi organici in bagni galvanici con «Cyclic Voltammetric Stripping» (CVS), «Cyclic Pulse Voltammetric Stripping (CPVS) e cronopotenziometria (CP). La sonda di misura sostituibile consente il cambio rapido tra le varie applicazioni con elettrodi diversi.

Per il controllo, la registrazione e la valutazione dei dati è necessario il software **viva**.

L'884 Professional VA manual per MME viene fornito con una vasta gamma di accessori e una sonda di misura per elettrodi Multi-Mode pro. Il set di elettrodi e la licenza **viva** devono essere ordinati separatamente.