



# In-line UV spectroscopy for imbalance detection and rebalancing in ICRFB Stefan Bester, Heinrich Peters, Nico Mans, Henning Krieg

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### Introduction

## **Aim and objectives**

A main challenge of iron chrome redox flow batteries (ICRFBs) is the capacity decay caused by the increasing imbalance due to (i) parasitic side reactions (ex.  $H_2$  production) and (ii) electrolyte cross-over between the electrolyte reservoirs.<sup>1</sup> The capacity loss can be rectified using either chemical or electro-chemical rebalancing.<sup>2</sup> However, an accurate in-line analytical technique is required to determine the extent of imbalance, and hence the amount of rebalance required.

The aim was to examine the ICRFB's transient behaviour using UVspectroscopy. The objectives were:

- Evaluate the suitability of in-line UV-spectroscopy as a real-time ulletmonitoring method.
- Examine the influence of sample temperature on the UV spectra of ulletFe<sup>2+</sup> and Cr<sup>3+</sup>.
- Assess the suitability of in-line UV-spectroscopy for measuring imbalance and rebalance.



Absorbance of (a) Cr<sup>3+</sup> & (b) Fe<sup>2+</sup> measured after charge and discharge (2 cycles) at 45°C and 65°C

## Conclusion

In-line UV spectroscopy is a suitable real-time monitoring technique capable of detecting imbalances and rebalancing within ICRFB at both 45 °C and 65°C. Further testing is required to understand the variations of specifically Fe<sup>2+</sup> absorbance with varying temperature.

Absorbance of Fe<sup>2+</sup> (930 nm) and Fe<sup>3+</sup> (430 nm) during rebalance at 65°C

#### References

1.Wang, W. et al. (2012) "Recent progress in Redox Flow Battery Research and Development," Advanced Functional Materials, 23(8), pp. 970–986. Available at: https://doi.org/10.1002/adfm.201200694 2.Nourani, M. et al. (2019) "Elucidating effects of Faradaic Imbalance on vanadium redox flow battery performance: Experimental characterization," Journal of The Electrochemical Society, 166(15). Available at: https://doi.org/10.1149/2.0851915jes.