Aqueous Sodium Ion Electrode Inks for Printed Batteries

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Deposition methods of electrode inks on to the current collector are, at present, well documented. However, with the rise of 3D printing emerging into the forefront of manufacturing[1], it is a natural progression for the technique to be considered for the fabrication of energy storage devices. Screen printing is an interesting technique (See Figure 1) for the deposition of electrode inks, which could be used effectively, to not only manufacture standard battery electrodes, but to facilitate further research into wearable electronics. The process is appealing due to its versatility; the current collector is not limited to metal foils and inks with high viscosities can be utilised[2].

Aqueous processing of these inks is a big challenge, however sodium ion cathode materials based on Prussian Blue analogues (PB) are a promising candidate. Due to their simple synthesis and excellent cycling stability, PBs have undergone extensive research for use in sodium ion batteries[3]. Yet, a systematic study of the rheology, printability and formation of the PB inks remains unexplored to date.

This study aimed to demonstrate the reproducibility of screen printed, sodium ion cathodes compared to conventional methods. Mechanical performance and active material dispersion were also investigated to obtain an optimal binder: conductive additive: PB ratio.

Many water soluble binders such as carboxymethyl cellulose, polyacrylic acid, xanthan gum and sodium alginate were explored to reveal a superior binder in terms of electrochemical performance and material dispersion. Analytical techniques such as SEM and electrochemical impedance spectroscopy (EIS) were used to determine how well each electrode aged after cycling.

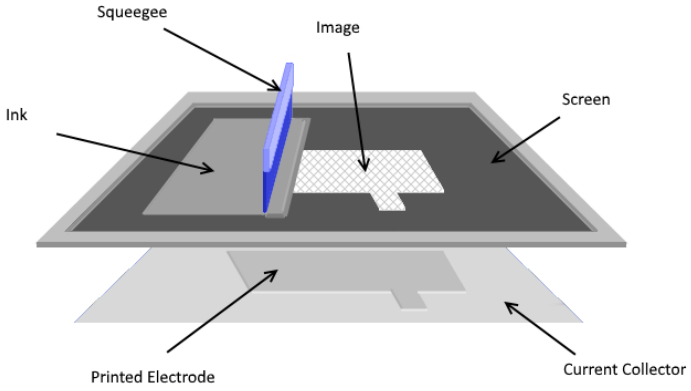

Figure 1 Schematic of screen printing

References:

[1] B. Campbell, Thomas Williams, Christopher Ivanova, Olga Garrett, Strategic Foresight Report, (2012), 3–7
[2] D. Novaković, N. Kašiković, G. Vladić, and M. Pál, “Screen Printing,” Print. Polym., (2016) 247–261
[3] F. Ma, Q. Li, T. Wang, H. Zhang, and G. Wu, Sci. Bull., vol. 62, no. 5, (2017) 358–368.