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An *in situ* graphite-grafted alkaline iron electrode for iron-based accumulators

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Iron is the fourth most abundant element on the earth. It is cost effective, has large theoretical specific capacity and is non-toxic. Accordingly, there is an increased interest in developing iron-based accumulators. The main parasitic reaction on iron electrode is hydrogen evolution that occurs while charging the iron electrode and brings about a decrease in its charge acceptance.[1]

An *in situ* graphite-grafted alkaline iron electrode prepared from the active material obtained by decomposing α-$FeC_2O_4.2H_2O$–polyvinyl alcohol (PVA) composite at 600°C in vacuum is reported.[2] The active material comprises a mixture of graphitic carbon coated α-Fe and Fe_3O_4 with the former being the prominent component. A specific discharge capacity of ~400 mAh/g is obtained with a faradaic efficiency of 80% at a current density of 100 mA/g (Fig. 1). The enhanced performance of the alkaline iron electrode is attributed to increased amount of metallic iron in the active material (Fig. 2) and its concomitant in-situ graphite grafting.

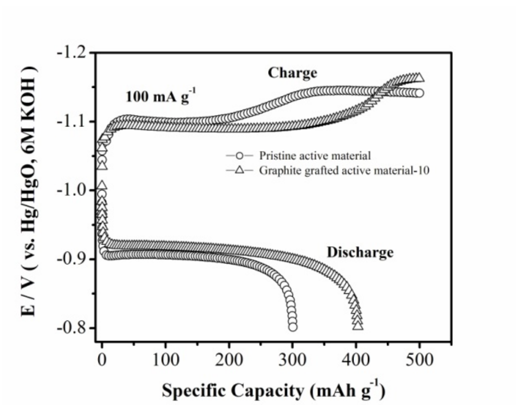

Fig. 1: Typical charge and discharge potential profiles for alkaline iron electrode made from pristine active material and graphite-grafted active material (GGAM−10).

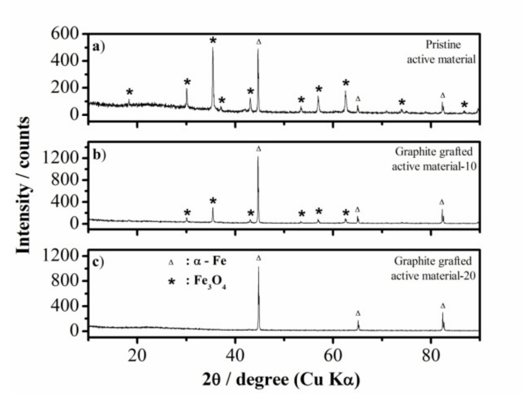

Fig. 2: XRD patterns for pristine active material (a) obtained by decomposing α-$FeC_2O_4.2H_2O$ and for graphite-grafted active materials (GGAM−10 (b) and GGAM−20 (c)) obtained by decomposing α-$FeC_2O_4.2H_2O$ – 10 w/w % PVA composite and α-$FeC_2O_4.2H_2O$ – 20 w/w % PVA composite.

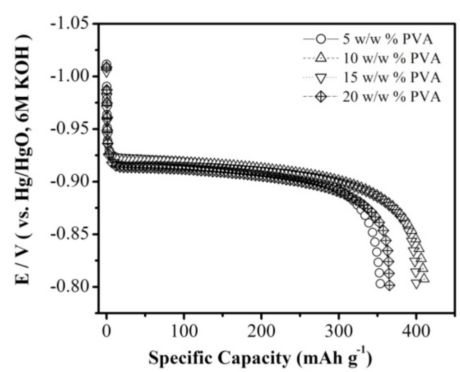

Fig. 3: Specific discharge capacities of iron electrode made from graphite-grafted active material with varying PVA content in the precursor (in w/w %).

The discharge potential profiles for graphite-grafted iron electrodes with varying amounts of PVA in the precursor composite are shown in Fig. 3. A precursor composite with 10 w/w % of PVA is found to be optimum, which delivers a specific discharge capacity in excess of 400 mAh/g at 100 mA/g.

References

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2. A. K. Shukla, S. Sampath and A. Sundar Rajan, 2177/CHE/2013, Patent pending.