Electrodeposited Tin Film Anodes for Energy Storage Applications

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The impetus for environmentally clean technology in automotive industry has led to several breakthrough research activities and the development of high energy storage batteries, which in turn has evolved into a lucrative market over the past few years. Lithium-ion batteries have thus dominated the energy storage market over the past three decades. However, concerns have been expressed in the industry of late due to the high costs and availability involved with lithium. For this reason research has been focused on sodium as a potential material for low cost portable energy storage devices. Initial studies have shown that sodium batteries have the capability to match and exceed lithium-ion batteries in terms of rate capability, life cycle and specific power[1]. This coupled with low manufacturing costs involved with sodium batteries and the larger abundance of Na makes it a potential material for future research. In this regard, tin has shown high capacity as an anode for Li-ion batteries and hence, it can translate into a potential material for initial studies for Na-ion batteries. Our recent study has shown tin-graphite composite synthesized using high energy mechanical milling (HEMM) to be a potential anode material for sodium ion battery[2]. However, the stability of the battery is still an issue and can be improved by employing better synthesis techniques to produce amorphous or nano-crystalline thin films.

In the current study, thin-films of tin (Sn) were deposited on copper (Cu) foil from various salts by an electro plating technique using aqueous and non-aqueous electrolytes employing an in-house electrochemical cell [3,4]. Scanning Electron Microscopy (SEM) studies were performed to study the effect of deposition parameters such as current density, voltage, pH and deposition time on the morphology of the deposited films.

Fig.1 shows the X-Ray diffraction pattern of the deposited Sn film showing the presence of Sn films deposited on the copper substrate. Fig.2 shows an SEM image of the tin film deposited under galvanostatic conditions from an aqueous solvent. A comparative study was also conducted on electro deposited thin films derived from aqueous and non-aqueous media. Electrochemical characterization studies were performed in a half cell configuration using Li/Na metal as counter and reference electrode. Charge-discharge characteristics, cyclability and rate capability of electroplated Sn films are currently studied as potential anodes for Li^+ and Na^+ batteries. Results of the Sn film batteries showing improved specific capacity and cyclability will be presented and discussed.

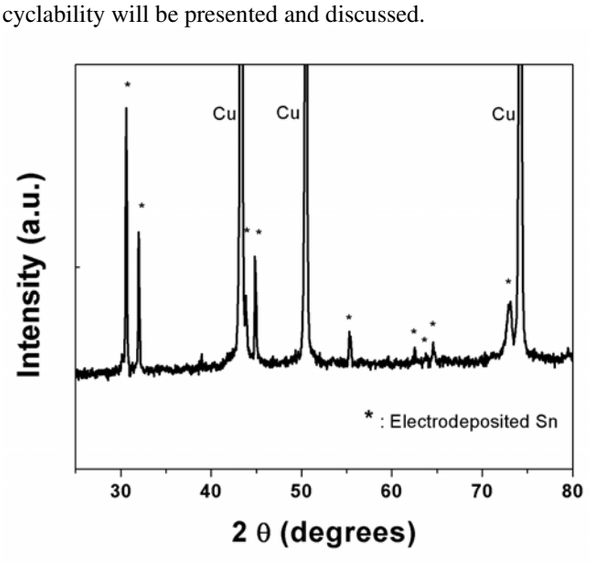

Fig 1: XRD pattern for electrodeposited Sn on Cu.

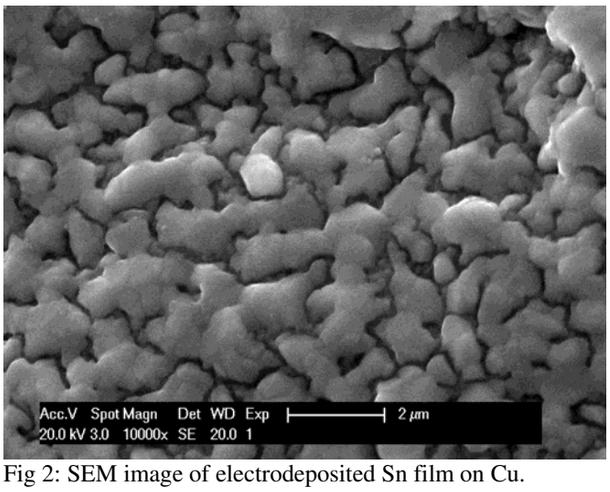

Fig 2: SEM image of electrodeposited Sn film on Cu.

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