Investigation of the electrochemical properties of Vanadium-based oxides for thin film electrodes

Youn-Su Kim, Hyo-Jin Ahn, and Tae-Yeon Sung
Department of Materials Science & Engineering,
Gwangju Institute of Science & Technology,
Gwangju, 500-712, S. Korea

Vanadium oxide (V_2O_5) thin films are of considerable interest for their extensive application as electrodes for rechargeable thin film batteries, optical electrochromic devices, and gas sensors due to their characteristic structural, electrochemical, and optical properties. In particular, because of promising developments with respect to microelectronic mechanical systems, micro-devices, smart card, and small sensor, the fabrication of high-quality thin film batteries become increasingly important. Rechargeable thin film batteries have been developed with anode materials such as graphite, SnO_2, and WO_3 and cathode materials such as MoS_2, $LiCoO_2$, $LiMn_2O_4$ and V_2O_5. Among the oxide cathode films, V_2O_5 is a promising candidate for active cathode materials for use in rechargeable thin film batteries, because of its high volumetric capacity, high voltage range, and easy insertion and extraction.[1-3]

In this work, to improve the cyclic behaviour and capacity of the V_2O_5 cathode, other oxides such as Mo-oxide were incorporated into V_2O_5 by a co-sputtering system. The electrochemical properties of the V-based oxide thin film electrodes were investigated and compared with that of the V_2O_5 films. The microstructures of V-based oxide electrodes were examined using X-ray diffraction, scanning electron microscopy, high resolution electron microscopy, and X-ray photoelectron spectroscopy. Electrochemical tests were performed using cycler (WBCS 3000) in a 0.75 M $LiCF_3SO_3$ (PC:DME=1:2) solution. Cycling tests were carried out for up 100 cycles in the range of 1.5 V to 3.6 V at constant current density was 20㎂/㎠.

Figure 1 shows XRD plots obtained form the V-based oxide thin films. It is shown that all the oxide films have amorphous structure. It is further shown that the electrochemical behaviors of the microstructure-controlled thin film electrodes for lithium insertion and extraction are dependent on the microstructure and hence the amount of MoO_3 that were incorporated into the V_2O_5 films. The relationship between the electrochemical and structural properties are described and discussed.

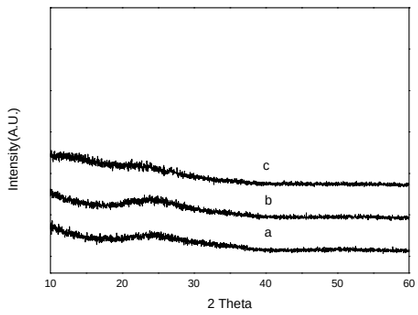

Figure 1. XRD plots for the V-based oxide thin films. (a) V_2O_5 only, (b) and (c) V_2O_5-MoO_3 that were deposited at RF powers of 20 and 30 W for MoO_3, respectively.

References

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