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Characterization of All-Solid-State Thin Film Batteries (TFBs)

Hee-Soo Moon, Young-Jae Kim, Jung-Nam Kim and Jong-Wan Park*

Division of Materials Science and Engineering,
Hanyang University
17 Haengdang-dong, Seongdong-gu,
Seoul, 133-791, Korea
*jwpark@hanyang.ac.kr

Demand for low power, battery operated devices is on the rise, particularly in portable equipment needing longer operation with higher reliability. Advances in the microelectronics industry and the miniaturization of electronic devices have reduced the current and power requirements of some of these devices to extremely low levels. This has made possible the use of thin film batteries (TBFs) as power sources for these devices. Therefore, it is important to develop long lasting and high-energy efficient TFBs, which can be as an integral part of microelectronic circuits.

TFBs made with solid-state thin film components can realize an appropriate capacity by adjusting thickness and deposition area. With using solid -state electrolytes, such as LIPON and polymer electrolyte, TFBs can be relatively free from the problems of bulk-type secondary batteries.

Typical structure of TFBs is multilevel thin films consisting sequentially of current collector/cathode/ solid electrolyte/anode/current collector/protective layer (Fig. 1 and Fig. 2). These thin films are deposited by chemical vapor deposition (CVD) or physical vapor deposition (PVD) methods utilizing microelectronic technologies [1].

In this work, we fabricated TFBs using rf magnetron sputter, E-beam evaporator and doctor-blade method. Lithium manganese oxide, LIPON (or solid polymer electrolyte, $P(EO)_{10}LiTFSI$+5 wt% R812+6 wt% D4CN) and lithium metal were used as the cathode, solid electrolyte and anode, respectively. Pt-deposited $TiO_2/SiO_2/Si$ wafer was used as substrate. The thickness of LIPON and SPE was about 1.4 μm and 100 μm, respectively. Lithium metal was deposited on LIPON by thermal evaporator. When polymer electrolyte used, lithium metal and electrolyte stacked by mechanical pressing.

Surface roughness and morphologies of the each film was measured by AFM and FE-SEM. The chemical bonding was analyzed by XPS. Cathode electrode was performed the half-cells test. In this test, we used 1 M solution of $LiPF_6$ in EC-DMC(1:1) as liquid electrolyte.

Figure 3 showed discharge capacities of the TFBs we fabricated using solid polymer electrolyte.

The more results will be presented in the meeting.

ACKNOWLEDGEMENT

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[1] J. Schoonman and E. M. Kelder, J. Power Sources, **68**(1997) 65

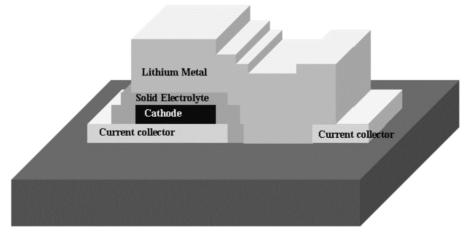

Figure 1. Typical structure of the TFBs.

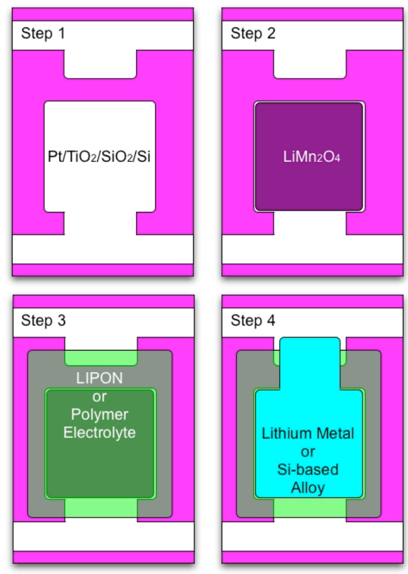

Figure 2. Process sequence of the TFBs.

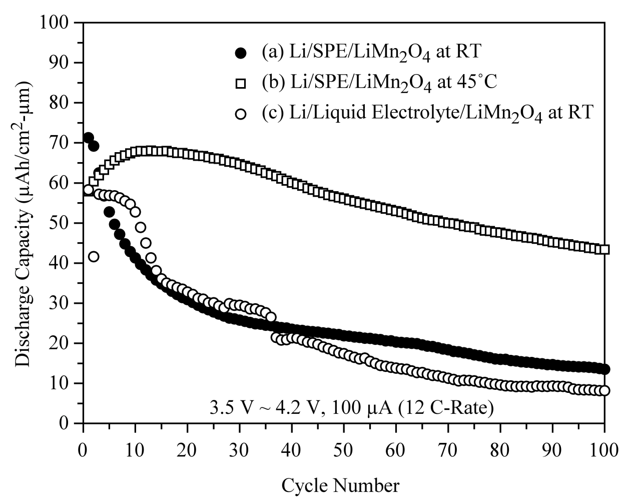

Figure 3. Discharge Capacities of TFBs