Electronic Supplementary Material (ESI) for Dalton Transactions

Porous Mg thin films for Mg-air batteries

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Detailed experimental procedures, AFM images and XRD patterns of Mg films prepared under different substrate temperatures, and discharge curves of different Mg films at various discharge current densities.

1. Experimental procedures

1.1 Film preparation

Mg thin films were prepared under four different substrate temperatures using a custom designed direct current (DC) magnetron sputtering system with a background pressure of around 2×10^{-4} Pa. Before and during deposition, the substrate was heated to and maintained at a temperature 25°C, 80°C, 120°C and 150°C, respectively. Then, 100nm Mg films were deposited onto Si (110) wafers and glass substrates using a Mg (99.99%) target. The magnetron discharges were generated under an argon pressure (99.99%) of 0.6 Pa with the flow rate of 76 sccm. After deposition, the samples were

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transferred into a vacuum chamber to avoid oxidation.

1.2 Structural characterizations and electrochemical measurements

The structures and electrochemical performances of different Mg films were systematically studied. The structures of the samples were examined by powder X-ray diffraction (XRD) (Rigaku D/max-200) using monochromated Cu Kα radiation and □ θ-2θ scan. The surface morphologies of different films were studied by scanning electron microscopy (SEM) (Hitachi S4800) and atomic force microscopy (AFM) (NANOSCOPE III, DI Corporation, USA) measurements. The electrochemical properties of different Mg film electrodes were investigated at room temperature in 6M KOH solution on a CHI 660B electrochemical workstation with a three-electrode cell. Platinum foil and a Hg/HgO electrode were used as the counter and reference electrode, respectively. The laboratory-made Mg-air batteries were assembled with the Mg thin films anodes, an air electrode and 6M KOH electrolyte. The as-deposited Mg films were directly used as the anodes, and the air electrode was commercial Pt-C catalyst. For comparison, traditional Mg pellet has also been prepared by pressing the commercial Mg powers under high pressure. The discharge performance of Mg-air batteries was studied by means of constant current discharge test to an end voltage of 0 V at room temperature, with a discharge current density of 0.1 mA cm^{-2}.

2. Figures

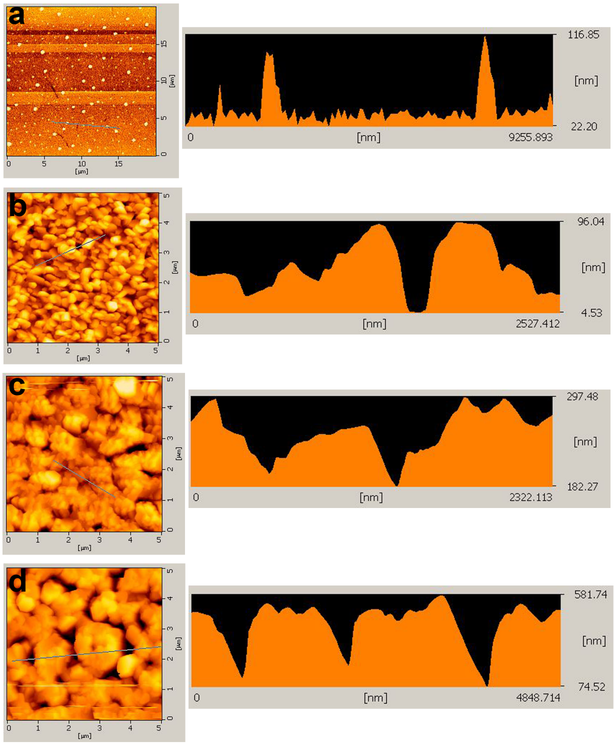

Fig. S1. AFM images of Mg films prepared under different substrate temperatures: (a) 25°C (b) 80°C (c) 120°C (d) 150°C.

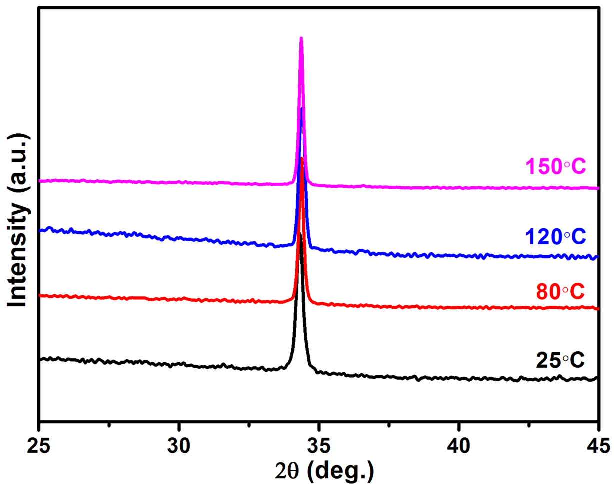

Fig. S2. XRD patterns of Mg films prepared under different substrate temperatures.

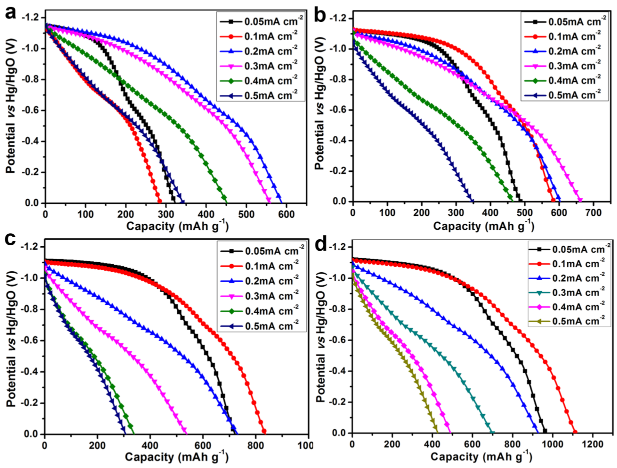

Fig. S3. Discharge curves of different Mg films at various discharge current densities: (a) 25°C (b) 80°C (c) 120°C (d) 150°C.