Supplementary Information

Solar Powered New Lithium – Ion Battery Incorporating High Performing Electrode Materials

S. Gopukumar[a]*, C. Nithya[a], P. H. Maheshwari[b], R. Ravikumar[a], , R. Thirunakaran[a], A. Sivashanmugam[a], S. K. Dhawan[b], R. B. Mathur[b]

[a] *CSIR-Network Institutes of Solar Energy (CSIR-NISE), CSIR-Central Electrochemical Research Institute, Karaikudi, India – 630 006.*
[b]*CSIR-National Physical Laboratory (CSIR-NPL), New Delhi, India-110 007.*

Experimental Section

Synthesis of carbon paper and $LiMg_{0.025}Cu_{0.175}Co_{0.8}O_2$ materials. Synthesis procedure of carbon paper and $LiMg_{0.025}Cu_{0.175}Co_{0.8}O_2$ are described elsewhere in patent[1].

Material Characterization. The synthesized electrode materials was identified by powder x–ray diffraction ('Xpert PRO PAN alytical PW 3040/60 'X'Pert PRO') using Cu–Kα radiation with the step size of 0.1°/min while the voltage and current held at 40 kV and 20 mA respectively. The surface morphology of the materials was characterized by scanning electron microscope (SEM HITACHI S–3000H from Japan). The electrical conductivity of the synthesized materials was determined by using four–probe DC method (SES Instruments) from a set of voltage–current values using a power source controlled by a PC. The values were obtained by taking $\sigma = 1/\rho$, $\rho = RA/L$ where L is distance between voltage contacts and A is the sample cross section.

Electrochemical Measurements. Electrochemical tests (versus lithium) were conducted in 2016 coin type cells. The cells were assembled in argon filled glove box in which lithium foil is used as reference electrode for both carbon paper and $LiMg_{0.025}Cu_{0.175}Co_{0.8}O_2$, cellgard as the separator and 1M $LiPF_6$ in 1:1 (v/v) EC: DEC as the electrolyte. The cathode making procedure is described elsewhere in our previous publication[2]. Galvanostatic charge/discharge tests were conducted using programmable battery tester (BasyTec Test systems) at various C–rates (0.2, 0.5, 1 and 2C) between 2.9–4.6V versus Lithium. The lithium ion cell was assembled using graphite–based carbon paper as the negative electrode and cathode was made into 18 mm pellets and the electrolyte used as the same. The cells are cycled between 2.9–4.2V at 1C and 2C rates. The assembled cell was also charged by using solar panel (commercial). Cyclic voltammetric measurements were performed using an EG&G instruments (Princeton Applied Research) at a scan rate of 0.1 mVs^{-1} between 2. 9 and 4. 6V.

References

1. S. Gopukumar, C. Nithya, R. Thirunakaran, A. Sivashanmugam. Cathode Material and Lithium ion Battery Therefrom — Pub. No: WO/2012/052810.

2. C. Nithya, R. Thirunakaran, A. Sivashanmugam, G. V. M. Kiruthika, S. Gopukumar *J. Phys. Chem. C* 2009**, 119**, 17936.