Influence of deep sea environment on the performance of a $LiFePO_4$ polymer battery

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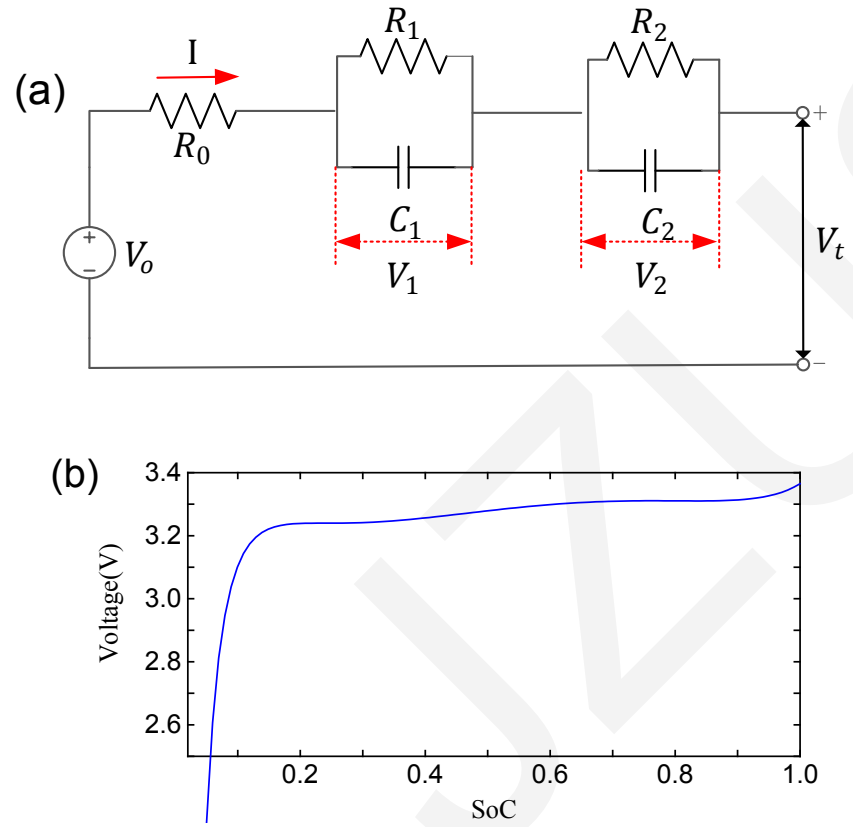
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BATTERY MODELING



$$\frac{dV_1}{dt} = -\frac{V_1}{R_1C_1} + \frac{I}{C_1},$$

$$\frac{dV_2}{dt} = -\frac{V_2}{R_2C_2} + \frac{I}{C_2},$$

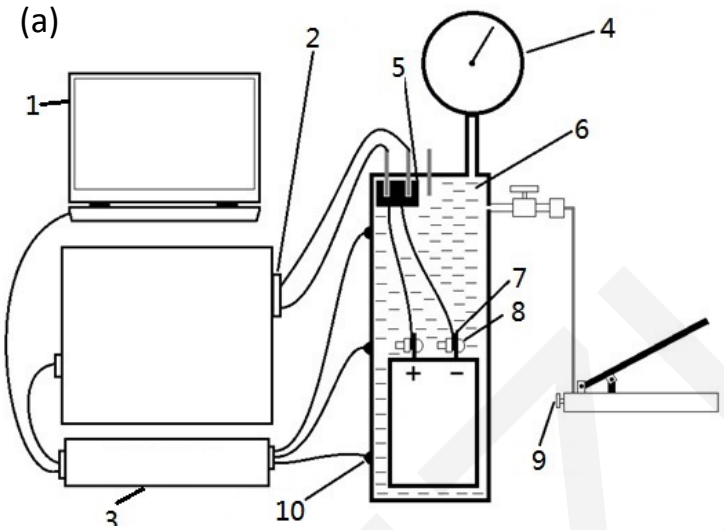
$$V_t = V_{oc} - V_1 - V_2 - IR_0,$$

$$V_{oc} = g(\mathrm{SoC}),$$

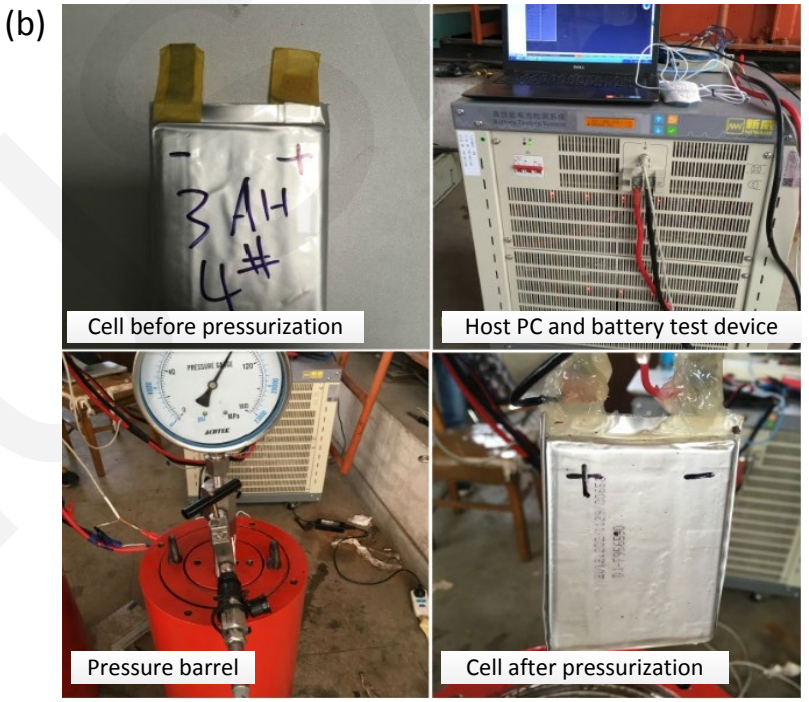
$$\mathrm{SoC} = \mathrm{SoC}_0 + \frac{1}{Q_0}\int_0^t I(\tau)d(\tau).$$

(a) A schematic of the second order ECM; (b) the fitting curve of OCV-SoC at 20 ° C.

EXPERIMENT AND CALCULATION METHOD

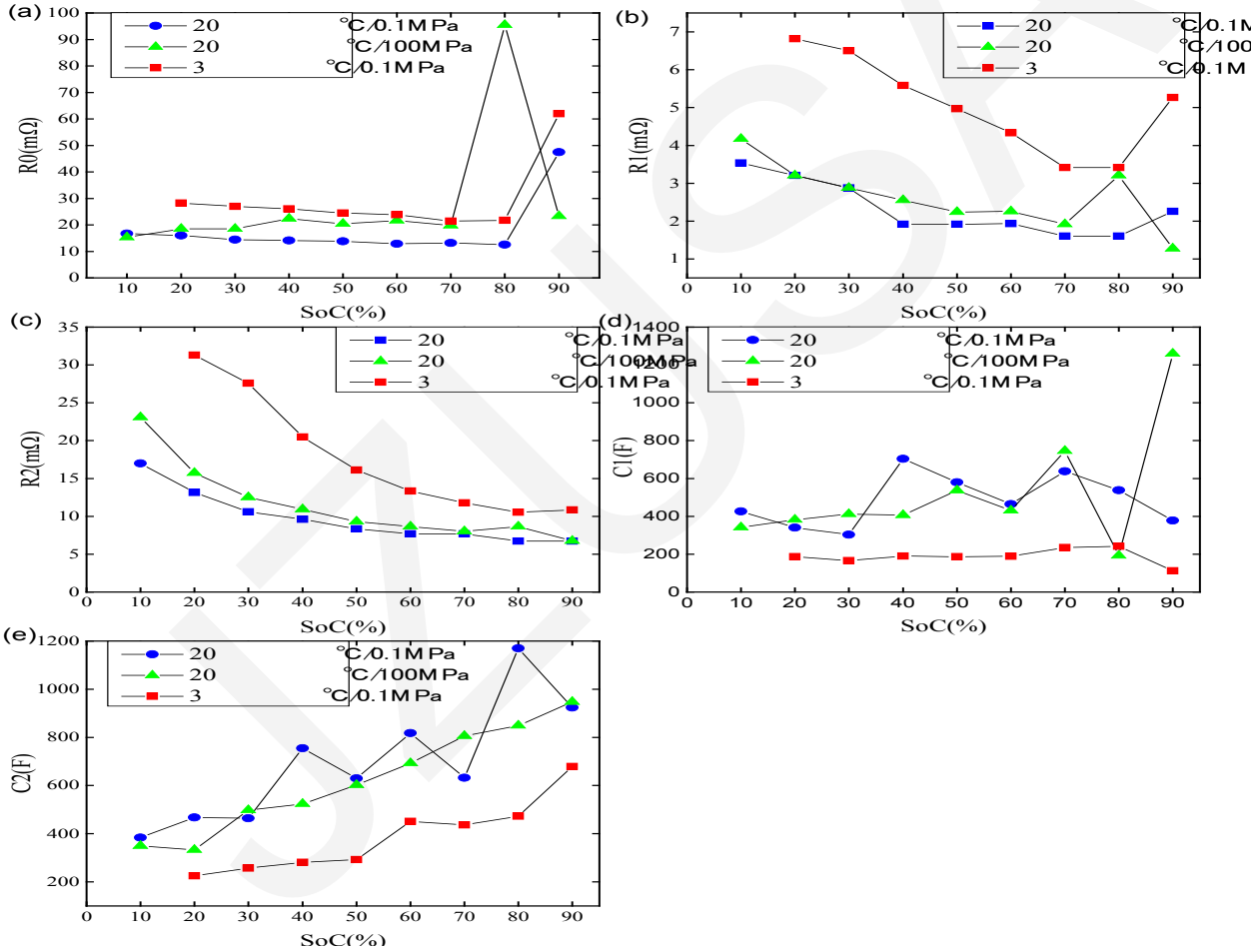


1.Host PC
2.Battery test device
3.Auxiliary channel
4.Pressure gauge
5.Electrical connection
6.Insulation oil
7.Cell electrodes
8.Connecting bolts
9.Pressure pump
10.Temperature sensors



(a) A schematic of the experimental setup; (b) photographs of the battery test bench.

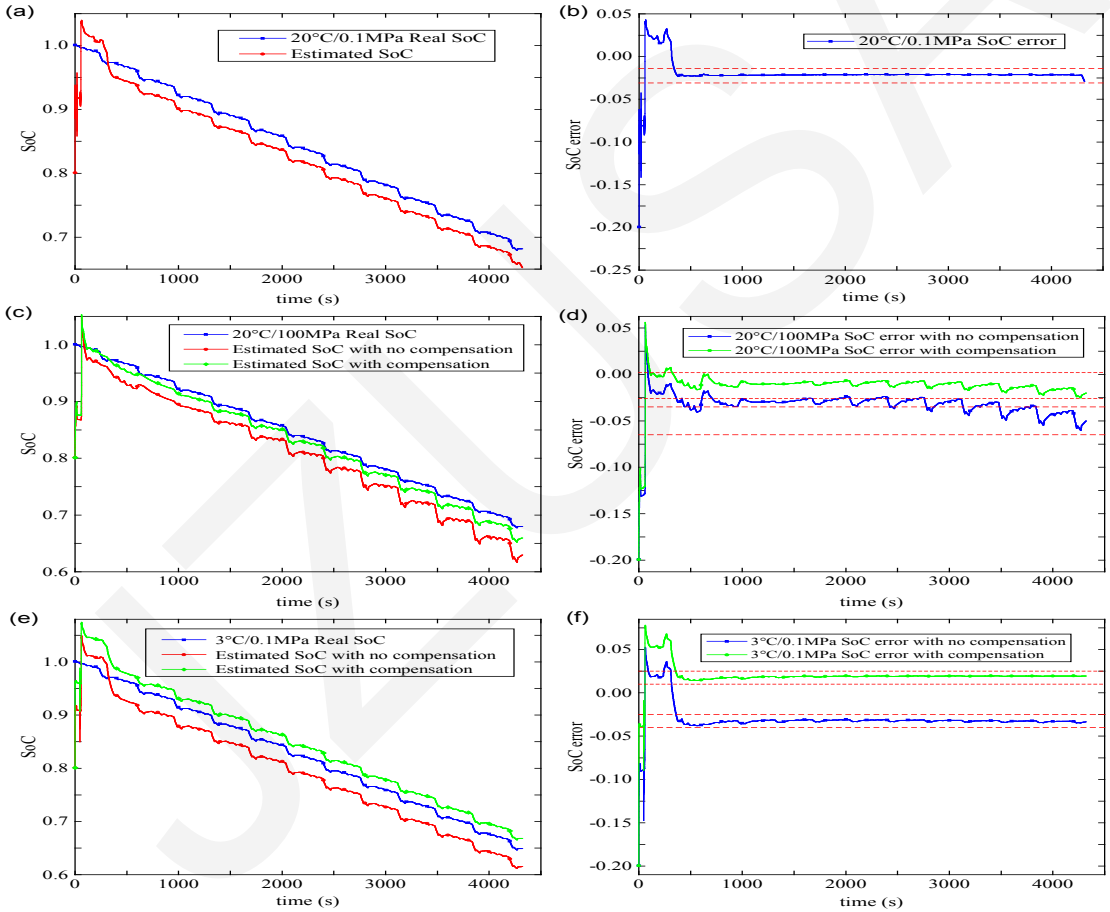
PARAMETERS IDENTIFICATION



Parameters $R_i(i=0,1,2)$ and $C_i(i=1,2)$ in three environmental conditions: (a) ohmic resistance R_0, (b) resistance R_1, (c) resistance R_1, (d) capacitance C_1, (e) capacitance C_2

$$K = P_{xy,k} P_{y,k}^{-1}$$
$$\hat{x}_k = \hat{x}_k^- + K(y_k - \hat{y}_k^-)$$
$$P_{x,k} = P_{x,k}^- - K P_{y,k} K^T$$

SOC ESTIMATION RESULTS



SoC estimation results in different environments: (a) estimated value versus real value at 20 ° C/0.1 MPa, (c) estimated value versus real value at 20 ° C/100 MPa, (e) estimated value versus real value at 3 ° C/0.1 MPa; (b) SoC estimation error at 20 ° C/0.1 MPa, (d) SoC estimation error at 20 ° C/100 MPa; (f) SoC estimation error at 3 ° C/0.1 MPa