For the development of high-energy battery, iron trifluoride (FeF$_3$) is one of the attractive cathode active materials because of low cost, environmentally benign, and its high theoretical capacity of 712 mAh g$^{-1}$ [1]. However, the charge-discharge cycle performance of FeF$_3$ is insufficient for practical use. Previously one of the authors reported the effect of the electrolyte additive (e.g. anion receptor) to improve the FeF$_3$ cycle performance [2]. In this study, we investigated the influence of the electrolyte solution on the cycle performance of FeF$_3$ to clarify the mechanisms of the cycle degradation.

FeF$_3$ cathode material and the evaluation cell (CR2032; Li anode) were prepared in the manner previously reported [2]. Two types of electrolyte solution were used here; 1.0 mol dm$^{-3}$ LiPF$_6$ in EC/DMC (1/1 vol.), and in EC/PC (1/1 vol.) as solvents. Charge-discharge profiles of the FeF$_3$/Li cells were performed in the voltage 1.0-4.5 V at 25°C. Morphology of the FeF$_3$ cathode after cycles were observed by SEM (JEOL JSM-6700FV).

The FeF$_3$/Li cells with the EC/PC solvent showed excellent cycle performance compared to the cells with the EC/DMC solvent. SEM observations of the cathode after cycles revealed a formation of film on the FeF$_3$ surface, and its thickness in the ‘EC/PC’ cells was clearly thinner than that in the ‘EC/DMC’ cells. This finding suggests that the cycle performance of the FeF$_3$ cathode is adversely affected by the formation of the film on the FeF$_3$ surface. Thickness of these films could be reduced by optimizing the desirable solvent of the electrolyte solution.

Acknowledgment:
This work was financially supported by RISING2 project of NEDO, Japan.

References: