

## Analysis of the Formation Gases in Lithium Ion Battery

### 리튬 이온 이차전지의 Formation Gas 분석

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The gases are evolved when the battery undergoes the first charging (formation) process, the cycling, and the storage at high temperature. The kind and the amount of evolved gases are closely related to the nature of electrolyte, potential, and temperature. In order to understand the gas-evolving reactions within the battery, the gas analysis is essential. In this presentation, the gas evolution within the lithium-ion battery has been investigated using the in-situ or ex-situ GC/MS and the GC/TCD techniques for qualitative and quantitative analysis, respectively. During the formation process at the room temperature, hydrogen, alkane, and alkene called as formation gases are evolved. Some gases are evolved directly from the decomposition of electrolyte components at anode/cathode surfaces. However, it is also found that some oxidized products generated at the cathode diffuse to the anode where they transform into gases. In addition, the effects of solvent (DMC, DEC and EMC), salt (LiPF<sub>6</sub> vs. LiBOB), and anode material (graphite vs. hard carbon) on the gas evolution during the formation process will be discussed.

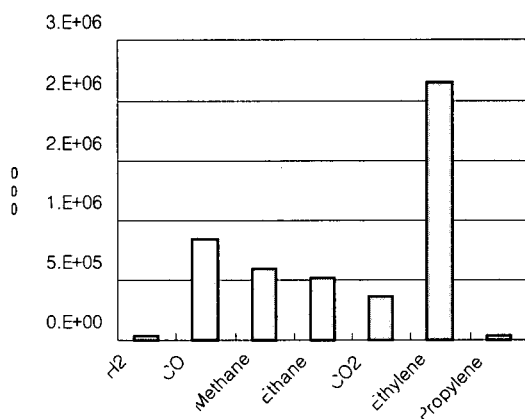


Fig. 1. The gas composition within the lithium ion battery during formation process. The electrolyte was 1M LiPF<sub>6</sub> in EC/EMC, 1:2 v/v. The gas analysis was performed with HP 6890A GC with TCD. To analyze hydrogen gas, the oven temperature was ramped from -80°C to 250°C and the Ar was used as carrier gas. Analyzed gas was injected by automatic sampling valve with the 1 ml of loop.