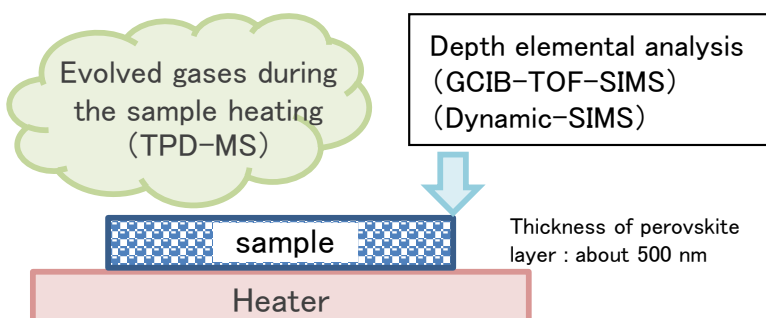


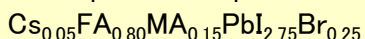
Evolved gas analysis by TPD-MS and depth profile analysis by SIMS of perovskite solar cells

Lead halide perovskite solar cells can be deposited using the coating process, and inexpensive and highly efficient solar cells have become available. To improve the heat treatment process, it is important to understand the decomposed gases from the material and the composition distribution in the material. Here, we show the evaluation results of evolved gases during heating by TPD-MS and the elemental distribution in the depth direction by GCIB-TOF-SIMS and Dynamic-SIMS.

The viewpoints of analysis



< composition of perovskite >



< measurement condition of TPD-MS >

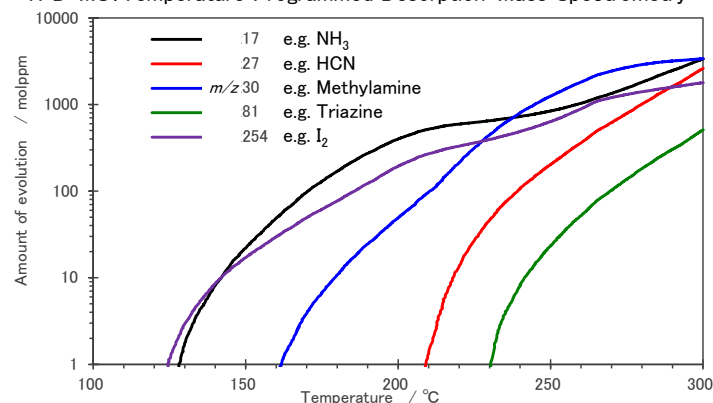
Carrier gas : He

temperature : 20°C ~ 300°C (max 1000°C)

Rate of temperature increase : 10°C/min

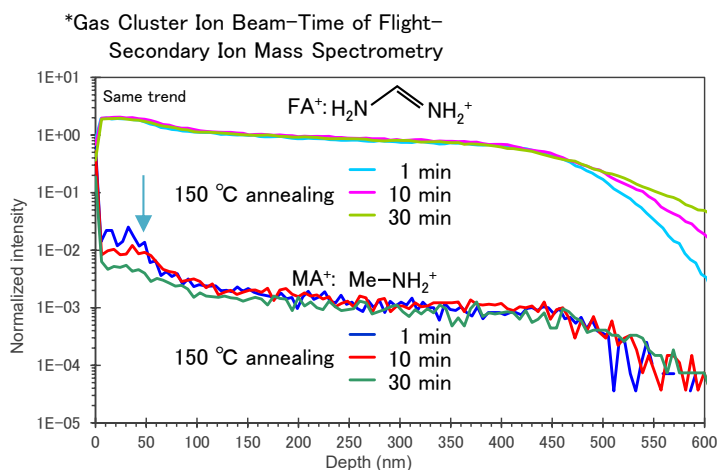
Heating evolved gas analysis (TPD-MS*)

*TPD-MS: Temperature Programmed Desorption-Mass Spectrometry



TPD-MS is real-time evolved gas analysis, and the concentration change of evolved gas from a sample heated according to temperature program is tracked as a function of temperature or time. We found that desorption of m/z 17 and m/z 254 occur from 120°C.

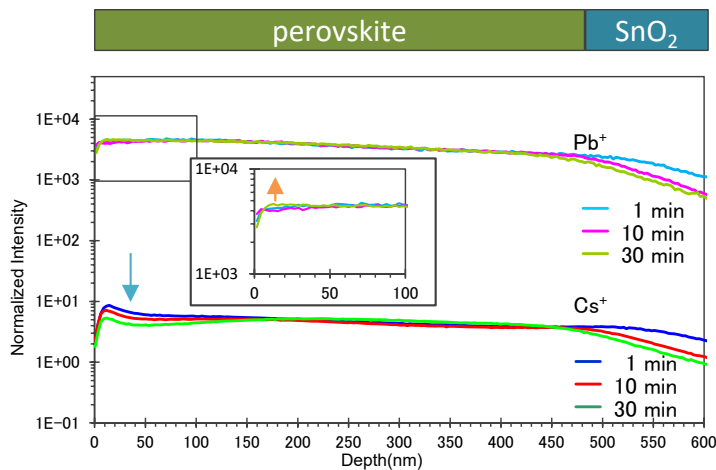
Depth analysis of organic components (TOF-SIMS)



As ion beam (typically Cs^+ , O_2^+ , Bi^{++}) is irradiated onto a surface of the perovskite, secondary ions are generated as a result of sputtering. The secondary ions are introduced into mass analyzer and then separated ones are detected. Continuous sputtering alternately irradiating etching ions provides depth profiling of components of the sample including impurities at lower levels owing to its high sensitivity. In addition, using GCIB for etching ions causes less damage to organic materials, and MA and FA can be evaluated as molecular ions. We found that same trend in FA at the surface with increasing annealing time, as indicate on the other hand, a decrease in MA and Cs, and an increase in Pb, as indicated by the blue and orange arrows in figures.

Sample was provided by Dr. Wakamiya, Kyoto univ., Japan

Depth analysis of Pb, Cs atom (Dynamic-SIMS)



We obtained the indices for material development from complex analysis such as TPD-MS and SIMS.