Organic-inorganic hybrid perovskite solar cells have attracted much attention as a low cost and high efficiency solar cell. Electrical properties, e.g. photoconductivity, of the perovskite layer is important for high quality devices, however, there are few reports of photoconductivity of perovskite films. An insulating substrate such as a glass substrate is required for the electrical characterization, however, the perovskite layer is prepared on TiO₂ coated TCO glass substrates by using spin-coating. Film-deposition using spin-coating is significantly influenced by substrate surface conditions, therefore, spin-coating is not suitable to investigate the relationship between electrical properties of the perovskite film and perovskite solar cell. Therefore, we employ vacuum evaporation for the deposition of perovskite (CH₃NH₃PbI₃-xClₓ) layer to investigate electrical properties.

We used CH₃NH₃I and PbCl₂ as source materials for vacuum evaporation. Eagle-XG glass is used for the substrate. The evaporated film was thermally annealed at 110°C for 45 min on a hot-plate in grove-box filled with dry air. The thickness of the annealed perovskite film is approximately 250 nm. The optical and electrical properties are investigated by photoluminescence (PL), transmittance, reflectance, ellipsometry, dark- and photo-conductivity and constant photocurrent method (CPM). The perovskite films with coplanar Au electrodes were used for the conductivity and CPM measurements.

Figure 1 shows the absorption coefficient of CH₃NH₃PbI₃-xClₓ measured by CPM measurements. Relatively low subgap absorption indicates that defect density of the film is relatively low. The bandgap $E_g$ was found to be ~1.55 eV. Photoconductivity measured under 1-sun condition (AM1.5, 100 mW/cm²) was in the order of 8.37×10⁻⁴ S/cm (dark conductivity : ~10⁻⁷ S/cm). The results of the conductivity measurement also indicate that quality of the film is good. The mobility-lifetime ($\mu\tau$) product was found to be 3.5×10⁻⁷ (cm²/V), which corresponds to the carrier diffusion length of ~1 μm. Time-dependent PL measurements revealed that emission lifetime is about 30 ns. These results indicate that high quality CH₃NH₃PbI₃-xClₓ film can be deposited by vacuum evaporation. Details of the characterization will be presented at the conference.

Acknowledgement
This work was funded by JSPS Grant-in-Aid for Scientific Research 26709075.