

CH₃NH₃PbCl₃ 単結晶基板上 CH₃NH₃PbI₃ 薄膜のエピタキシャル成長 Epitaxial growth of CH₃NH₃PbI₃ thin films on CH₃NH₃PbCl₃ single crystal substrates

東大工¹, 東大先端研² ○(M2) 劉子豪¹, 松下智紀^{1,2}, 近藤高志^{1,2}

School of Eng.¹, RCAST², Univ. of Tokyo ○Zihao Liu¹, Tomonori Matsushita^{1,2}, Takashi Kondo^{1,2}

E-mail: liuzihao@castle.t.u-tokyo.ac.jp

Metal halide perovskites have attracted significant attention because of the promising scenario of being the next generation photovoltaic materials. The materials exhibit unique properties such as strong absorption and long carrier lifetime. Recently the power conversion efficiencies of perovskite solar cells have reached 25.2%. So far most of these devices have been based on polycrystalline thin films grown by spin coating. To further study the properties of perovskites, single crystals are required, and we believe that single crystalline perovskites will also play an important role in functional devices. We have tried to grow CH₃NH₃PbI₃ (MAPbI₃) on CH₃NH₃PbBr₃ single crystal substrate, but only obtained CH₃NH₃Pb(Br_{1-x}I_x)₃ alloy due to interdiffusion of halogen ions [1]. In order to get heterostructure of pure perovskites, we replaced the substrate with CH₃NH₃PbCl₃ (MAPbCl₃) single crystal, which has a larger mismatch.

MAPbCl₃ single crystal is fabricated by inverse temperature crystallization [2]. Then 200 nm MAPbI₃ thin film is grown by coevaporating CH₃NH₃I and PbI₂ on (001) surface of the substrate at a temperature of 21°C. The rate of PbI₂ is 0.15 Å/s. CH₃NH₃I is controlled by pressure and is kept at 0.0015 Pa. The pattern of 2θ/ω scan along normal direction of surface after coevaporation is present in Fig. 1, indicating that we have succeeded in growing pure MAPbI₃ on MAPbCl₃ single crystal substrate. This may be the result of the large lattice mismatch which could suppress interdiffusion. The inset of Fig. 1 shows that perovskite alloy still exists. Combining with the reciprocal space map in Fig. 2, we conclude that the alloy thin film formed pseudomorphically, and that the iodine composition is calculated to be about 1.3%. This is much smaller than that of bromide perovskite case. The detail of the thin film will be discussed in the presentation.

[1] K. Kimura, Y. Nakamura, T. Matsushita, T. Kondo, *Jpn. J. Appl. Phys.*, **58**, SBBF04, (2019).

[2] G. Maculan *et al.*, *J. Phys. Chem. Lett.*, **6**, 3781, (2015).

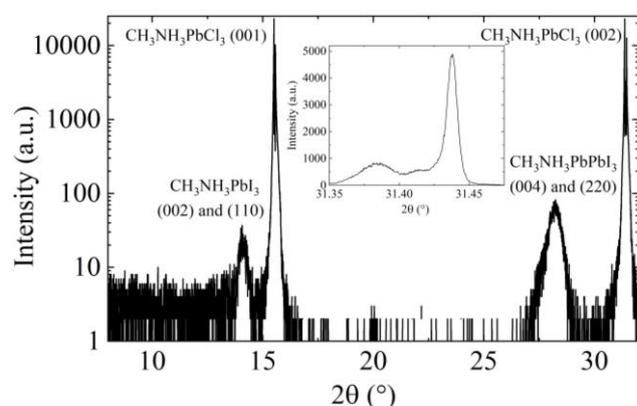


Fig. 1 XRD patterns of 2θ/ω scan after evaporation. The inset shows the detail of the substrate peak around (002).

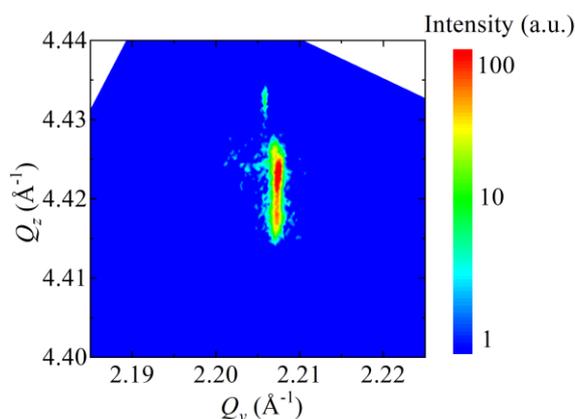


Fig.2 Reciprocal space map of the substrate and alloy around the diffraction peak (024).