

Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Temperature Dependent Surface Structures and Electronic Properties of Organic-Inorganic Hybrid Perovskite Single Crystals¹ M.-H. JAO, Natl Taiwan Univ, M. L. TEAGUE, J.-S. HUANG, W.-S. TSENG, N.-C. YEH, Caltech — Organic-inorganic hybrid perovskites, arising from research of low-cost high performance photovoltaics, have become promising materials not only for solar cells but also for various optoelectronic and spintronic applications. An interesting aspect of the hybrid perovskites is that their material properties, such as the band gap, can be easily tuned by varying the composition, temperature, and the crystalline phases. Additionally, the surface structure is critically important for their optoelectronic applications. It is speculated that different crystalline facets could show different trap densities, thus resulting in microscopically inhomogeneous performance. Here we report direct studies of the surface structures and electronic properties of hybrid perovskite $\text{CH}_3\text{NH}_3\text{PbI}_3$ single crystals by scanning tunneling microscopy and spectroscopy (STM/STS). We found long-range spatially homogeneous tunneling conductance spectra with a well-defined energy gap of (1.55 0.1) eV at 300 K in the tetragonal phase, suggesting high quality of the single crystals. The energy gap increased to (1.81 0.1) eV in the orthorhombic phase, below the tetragonal-to-orthorhombic phase transition temperature at ~ 150 K. Detailed studies of the temperature evolution in the spatially resolved surface structures and local density of states will be discussed to elucidate how these properties may influence the optoelectronic performance of the hybrid perovskites.

¹We thank the support from NTU in Taiwan and from NSF in the US

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Date submitted: 11 Nov 2016

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