第217回 OPERA研究交流セミナー
第208回 ISIT有機光エレクトロニクス研究特別室セミナー
第275回 未来化学創造センターセミナー

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場所：ハイブリッド開催／ISI棟３階セミナー室・-Zoom-

Development of high-performance Sn-based halide perovskite transistors

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In this talk, I would like to introduce a general overview and recent progress of our group for developing p-type metal halide perovskite and chalcogenide semiconductor as channel layers of field-effect transistors (FETs). In the first part of the seminar, I will talk about tin-based 2D and 3D perovskite semiconductors. At first, our approach to optimize 2D perovskite film for high-performance transistors will be addressed by various methods including self-grain boundary passivation, and Lewis base additive. Then inorganic 3D perovskite transistors with cesium-tin-triiodide-based semiconducting layers will be discussed. The $CsSnI_3$ transistors showed an exceptional performance using high crystallinity and uniform with moderate hole concentrations and superior Hall mobilities, which are enabled by the judicious engineering of film composition and crystallization. The optimized devices exhibit record high field-effect hole mobilities of over 50 square centimeters per voltage-second and large current modulation greater than 10^8, as well as high operational stability and reproducibility [1]. And I also introduce the triple halide approaches for achieving reliable transistor stability [2].

In the second part, I will introduce wafer-scale ultrathin (metal) chalcogenide semiconductors for high-performance complementary electronics using standard room-temperature thermal evaporation [3]. The n-type bismuth sulfide delivers an in-situ transition from a conductor to a high-mobility semiconductor after mild post-annealing with self-assembly phase conversion, achieving thin-film transistors with mobilities of over 10 $cm^2\ V^{-1}\ s^{-1}$, on/off current ratios exceeding 10^8, and high stability. Complementary inverters are constructed in combination with p-channel tellurium devices with hole mobilities of over 50 $cm^2\ V^{-1}\ s^{-1}$, delivering remarkable voltage transfer characteristics with a high gain of 200. This work has laid the foundation for depositing scalable electronics in a simple and cost-effective manner, which is compatible with monolithic integration with commercial products such as organic light-emitting diodes.

References:

[1] Ao Liu, Yong-Young Noh *et al,* Nature Electronics 5(2), 78-83 (2022)
[2] Huihui Zhu, Yong-Young Noh *et al,* Nature Communication, 13 1741 (2022)
[3] Ao Liu, Yong-Young Noh *et al,* Nature Communication, 13 6372 (2022)

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