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Local Imaging of Conductance Evolution in Ion-Gel-Gated Transitional Metal Dichalcoginide Transistors XIAOYU WU, DI WU, Univ of Texas, Austin, HONGTAO YUAN, HAROLD HWANG, YI CUI, Stanford University, KEJI LAI, Univ of Texas, Austin — Electrolyte-gated electric double layer transistors (EDLTs) have demonstrated carrier density modulation in a remarkably wide range in systems ranging from complex oxides to layered metal chalcoginides. Cryogenic microwave impedance microscopy (MIM) has been used to perform real-space mapping of nanoscale conductance evolution in oxide EDLT gated with an ultrathin ionic gel layer. However, such microwave imaging was previously only possible at temperatures lower than the glass transition temperature (frozen temperature) of the gel because of the contact-mode scanning. Here, we report in-situ imaging of conductance evolution in WSe_2 transistors using a MIM based on the frequency-modulated atomic force microscopy (FM-AFM) mode. With a typical tip-sample distance of 30nm, the WSe_2 EDLT can be simultaneously gate-modulated and imaged at 220K, which is above the frozen temperature of the gel. The microwave images vividly show the spatial evolution of channel conductance in WSe_2 during the metal-insulator transition and mesoscopic electronic inhomogeneity with different configurations of source/drain/gate voltages. Such in-situ microwave imaging provides new opportunities to correlate the macroscopic transport results and microscopic conductivity distribution in both equilibrium and non-equilibrium states of the EDLTs.

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