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High-resolution imaging of interfacial water: from water monomer to two-dimensional ice[1] YING JIANG, JING GUO, XIANGZHI MENG, JI CHEN, JINBO PENG, JIMING SHENG, LIMEI XU, XINZHENG LI, ENGE WANG, International Center for Quantum Materials (ICQM) and School of Physics, Peking University, Beijing 100871, P. R.China — Water-solid interactions are of broad importance both in nature and technology. The hexagonal bilayer model based on the Bernal-Fowler-Pauling ice rules has been widely adopted to describe water structuring at interfaces. Recently, we made a breakthrough in achieving submolecular-resolution imaging of individual water molecules using a scanning tunneling microscope (STM) [1]. Such a technique opens up the possibility of determining the detailed topology of H-bonded networks at water/solid interfaces with atomic precision. Thanks to the high-resolution STM imaging, we discover a new type of two-dimensional (2D) ice-like bilayer structure built from cyclic water tetramers on an insulating NaCl(001) film, which is completely beyond the conventional bilayer picture [2]. A novel bridging mechanism allows the interconnection of water tetramers to form chains, flakes and eventually a 2D extended ice bilayer containing a regular array of Bjerrum D-type defects. Ab initio density functional theory calculations substantiate this bridging growth mode and reveal a striking proton-disordered ice structure. [1] J. Guo, X. Z. Meng, J. Chen, J. B. Peng, J. M. Sheng, X. Z. Li, L. M. Xu, J. R. Shi, E. G. Wang*, and Y. Jiang*, Nature Materials 13, 184 (2014). [2] J. Chen, J. Guo, X. Z. Meng, J. B. Peng, J. M. Sheng, L. M. Xu, Y. Jiang*, X. Z. Li*, E. G. Wang, Nature Communications 5, 4056 (2014).

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