

True Atomic-Resolution Surface Imaging under Ambient Conditions via Conductive Atomic Force Microscopy

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Abstract

Atomic-scale characteristics of surfaces play a central role in numerous scientific fields. Yet, the tools utilized to characterize surfaces with atomic resolution rely on strict environmental conditions such as ultrahigh vacuum, limiting the relevance of results for realistic applications. Here, we report true atomic-resolution imaging via conductive atomic force microscopy (C-AFM) under ambient conditions [1]. Our approach delivers atomic-resolution maps on a variety of material surfaces that comprise defects including single atomic vacancies. Moreover, we report the capability of *in situ* charge state manipulation of defects on MoS₂, and the observation of an exotic electronic effect: room-temperature charge ordering in a thin transition metal carbide (TMC) crystal (i.e., an MXene), α -Mo₂C. Our findings herald the emergence of C-AFM as a powerful tool for atomic-resolution imaging and manipulation of surface structure and electronics under ambient conditions, with wide-ranging applicability.

[1] S.A. Sumaiya, J. Liu, M.Z. Baykara, *ACS Nano* **16**, 20086 (2022).

Biography

Mehmet Z. Baykara is a tenured Associate Professor and Graduate Chair at the Department of Mechanical Engineering at UC Merced, where he runs an atomic force microscopy lab focused on electronics, mechanics, and tribology at the atomic scale. A native of Istanbul, Turkey, he obtained his B.S. degree from Boğaziçi University in 2006, and his Ph.D. degree from Yale University in 2012. His doctoral thesis was recognized by the “Henry Prentiss Becton Graduate Award for Exceptional Achievement in Research” at Yale University. Prior to joining UC Merced, Mehmet worked as an Assistant Professor at Bilkent University, where he conducted research funded by the European Commission, and as Visiting Scholar at Columbia University and Harvard University. Mehmet authored publications in journals including *Nature Communications* and *Nature Nanotechnology*, and delivered numerous invited presentations at research institutes and universities around the world. He is the recipient of multiple academic awards, including those from the American Vacuum Society (AVS), Materials Research Society (MRS), and the German Physical Society (DPG).



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