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Quantum confinement engineering on a novel two dimensional electron gas based on $KTaO_3$ oxide interface[1] LUDI MIAO, JING WANG, RENZHONG DU, BAILEY BEDFORD, NATHAN HUBER, WEIWEI ZHAO, QI LI, Penn State University, QI LI'S RESEARCH GROUP TEAM — The discovery of two-dimensional electron gases (2DEGs) at transition metal oxide (TMO) surfaces and interfaces has opened up broad interest due to their exotic properties such as quantum Hall effect, 2D superconductivity and gate controlled ground states. Recently, $5d$ TMOs are hotly investigated due to their strong spin-orbit coupling (SOC), a key element of topological materials. Among them, $KTaO_3$ (KTO) not only hosts 2DEGs but also involves strong SOC. Here we report the discovery of electron gas based on KTO oxide interface, with low temperature mobility as large as $8000 cm^2 V^{-1} s^{-1}$. Strong Shubnikov-de Haas (SdH) oscillation in magnetoresistance is observed at 350 mK. Based on this playground we demonstrate a novel technique to perform quantum confinement engineering by inserting an insulating spacing layer into the interface. Indeed, we observed a drastic change in SdH oscillation from 3D-like behavior to 2D-like behavior. In addition, Fermi surface reconstruction due to the quantum confinement is also observed from SdH oscillation. Our results not only provide a novel playground for condensed matter physics and all-oxide device applications, but also open a promising new route in tailoring the dimensionality of electron gas systems.

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