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Observation of fractional quantum Hall effect in MgZnO/ZnO based heterostructures

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ZnO has been recognized as one of the key materials in Oxide Electronics, enabling UV emitters [1], thin film transistors, self-organized nanostructures, and spintronics. Among them, two-dimensional (2D) electron system at the MgZnO/ZnO heterointerfaces has attracted much attention for the device application of transparent field-effect transistors. The 2D electron gas (2DEG) at the interface is spontaneously generated by the polarization mismatch between MgZnO and ZnO layers. The first quantum Hall effect in oxides was observed for the 2DEG with an electron mobility of 5,500 $cm^2V^{-1}s^{-1}$ in pulsed-laser-deposition (PLD) grown MgZnO/ZnO [2]. The density of 2DEG could be tuned by the electrostatic field-effect [3] as well as the built-in Mg content [2]. By employing molecular beam epitaxy (MBE), the electron mobility could be enhanced to 20,000 $cm^2V^{-1}s^{-1}$ and detailed characteristics such as effective spin susceptibility were revealed [4]. The talk will cover the materials aspect, control of the 2D transport, enhancement of electron mobility over 100,000 $cm^2V^{-1}s^{-1}$, and quantum transport as well as fractional quantum Hall effect at low temperatures. This work has been carried out under the collaboration with the groups of M. Kawasaki, H. Ohno, and M. Shayegan.

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