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Enhanced thermopower of gate-induced ZnO two-dimensional electron gas[1] SUNAO SHIMIZU, RIKEN CEMS, MOHAMMAD S. BAHRAMY, RIKEN CEMS, University of Tokyo, TAKAHIKO IIZUKA, University of Tokyo, SHIMPEI ONO, RIKEN CEMS, CRIEPI, KAZUMOTO MIWA, CRIEPI, YOSHINORI TOKURA, YOSHIHIRO IWASA, RIKEN CEMS, University of Tokyo — Control of dimensionality has proven to be an effective way to manipulate the electronic properties of materials, thereby enabling exotic quantum phenomena, such as superconductivity[2], quantum Hall effects, and valleytronic effects[3]. Another example is thermoelectricity, which has been proposed to be favorably controllable by reducing the dimensionality[4]. We report the thermopower in a gate-induced two-dimensional electron gas (2DEG) formed at the surface of ZnO. Combining electric double layer transistor experiments and realistic tight-binding calculations, it is shown that, for a wide range of carrier densities, the 2DEG channel comprises a single subband, and its effective thickness can be reduced to several nanometers at sufficiently high gate biases. We demonstrate that the thermopower of the 2DEG region is significantly higher than that of bulk ZnO. Our approach opens up a novel route to exploit the peculiar behavior of 2DEG electronic states and realize thermoelectric devices with advanced functionalities.

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