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Intrinsic Bipolar Carrier (e^-/h^+) Layer on Clean Surface of Insulating $BaTiO_3$ Y. WATANABE, D. MATSUMOTO, Y. URAKAMI, S. KAKU, Kyushu U, Japan — **We show experimentally the electron/hole layer on the clean surface of insulating pure $BaTiO_3$ single crystals in ultra high vacuum, which is the first report of the *bipolar* surface carrier layer by the field effect on any oxide to our knowledge. The experiments here demonstrate that the surface carrier layer is not due to impurities or defects but is intrinsic due to the spontaneous polarization P_S.** The surface carrier layer induced by P_S was found to exist at least to 80K on atomically ordered surface of insulating $BaTiO_3^*$, which has become the basis of a recent new memory device. However, much skepticism about its intrinsic nature is unresolved. We report here the disappearance of the carrier layer above Curie temperature, its disappearance by the exposure to a low vacuum, which indicates its location as the top surface, and, both electron/hole carrier layers by P_S. Here, the control of the electron and hole surface layer is only through the direction of poling. The realization of the hole layer is clear evidence that oxygen vacancies are inessential to the formation of the carrier layer, because oxygen vacancies kill the hole carrier layers. The present results have various implications for the basis of ferroelectric electrics such as nano-ferroelectrics, field effects and domains. *Watanabe et al., *Phys. Rev. Lett.* 86, 332 (2001).

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