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Effect of disorder on the valley splitting on hydrogen terminated silicon (111) surfaces BINHUI HU, TOMASZ M. KOTT, ROBERT N. MCFARLAND, BRUCE E. KANE, University of Maryland, College Park — High quality hydrogen terminated Si (111) surfaces provide us with a new material system to study a two-dimensional electron system with multi-valley interactions. In our field effect structure where a H-Si(111) substrate is bonded to a SOI substrate, two-dimensional electrons are confined at the hydrogen-terminated Si(111) surface with a vacuum barrier. In our previous work, a high-mobility (μ=110,00cm2/Vs) sample shows sixfold degeneracy,[1] while on a sample with μ=24,000cm2/Vs, the sixfold degeneracy is broken.[2] In order to find out the relationship between the electron mobility and the valley splitting, we have investigated a number of devices with mobility (μ=10,000$\sim$25,000 cm2/Vs), and observed that most of them show the sixfold degeneracy, while a few of them show large asymmetry. Possible explanations will be presented. We will also compare the temperature dependence of the electron mobility between the high-mobility sample and a moderate-mobility sample, and discuss the possible different limiting factors behind them. [1] R. N. McFarland et al., Phys.Rev.B 161310R (2009). [2] K. Eng, et al., Phys. Rev. Lett. 99, 016801 (2007).

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