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Adsorption and desorption of hydrogen on Ge(100)-2×1: scanning tunneling microscopy (STM) and temperature programmed desorption (TPD) studies

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The adsorption and desorption of atomic hydrogen on Ge(100)-2×1 have been studied by scanning tunneling microscopy (STM) and temperature programmed desorption (TPD). For adsorption of hydrogen, at initially low coverage (< 0.1 ML), the singly occupied dimers (unpaired dangling bonds) as well as doubly occupied dimers are observed, which attributed to asymmetric bright spots on the one side of buckled dimers. At saturation coverage, the surface shows the local 3×1, 1×1 and surface etching on increasing hydrogen coverage at room temperature, while only 2×1 phase is observed for adsorption at 550 K. For desorption of hydrogen, STM and TPD observations show that the desorption of hydrogen from Ge(100)-2×1 follows a first order kinetics. By directly counting the number of desorption sites in the STM images, an activation barrier of E_d = 38 kcal/mol and a pre-exponential factor of υ_d = 2.7× $10^{13}s^{-1}$ were obtained using an Arrhenius plot over a temperature range of 500 - 550 K and at a coverage of 1.0 ML. The TPD simulations using these kinetic parameters are compared with experimental TPD results.