Effect of external strain on the order-disorder phase transition of the Si(001) surface

MASANORI YATA, National Research Institute for Materials Science — The Si(001) surface exhibits the phase transition from c(4×2) to the (2×1) structure at about 200 K[1, 2]. This is an order-disorder phase transition with respect to the buckling of the dimmer: the c(4×2) structure results from an antiferromagnetic ordering of the buckled-dimmer and the (2×1) structure is attributed to the time average of the flip-flop motion of the buckled-dimers. Externally applied tensile strain along the <110> direction on the Si(001) surface is found to induce the flip-flop motion of the buckled dimmer below the critical temperature. This motion occurs cooperatively to form the disordered domain of the (2×1) structure. Then the shape of the ordered domain as well as the size change with the strain. These results can be interpreted by the spontaneous shape instability originated from the strain relaxation energy. References [1] J. Ihm, D.H. Lee, J.D. Joannopoulos and J.J. Xiong, Phys. Rev. Lett. 51, 1872(1983). [2] T. Tabata, T. Aruga and Y. Murata, Surf. Sci. 179, L63(1987).