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Dissociative adsorption and self-assembly of CaF_2 on the Si(001)-4° off surface

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Depositing CaF_2[0.6% lattice-mismatch] on the Si(001)-4° off surface [composed of a single (001) domain with regularly-arrayed double-layer DB steps and located between (1 1 19) and (1 1 21)] held at 700 °C, CaF_2 molecules are preferentially adsorbed on the dimers and dissociated to Ca and F atoms. Dissociated Ca atoms form a silicide layer of a 2×3 structure on the (001) terrace, while F atoms are desorbed from the surface. Once the terrace is covered with a calcium silicide layer, CaF starts to be adsorbed selectively on the steps, as shown in Fig. (a). With CaF_2 deposition exceeding 1 ML, the (1 1 17) surface having 1-D CaF_2 nanodots are formed as shown in Fig. (b). By the present STM study, it has been clearly disclosed that the calcium silicide interfacial layer is pre-formed prior to adsorption of CaF_2 on vicinal Si(001) surface.

Keywords: Vicinal Si(001) surface, CaF_2, CaF, Calcium silicide