Three commuting phases during Si(5 5 12) homoepitaxy: Confirmation of two-chain structural model of Si(5 5 12)

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From the filled-state and empty-state STM images of Si(5 5 12)-2x1 surface, its structural model has been redefined. In this new structural model, differently from the previous models, two kinds of chain-structures, the honeycomb (H) chain and the 6-5 ring π-bonded (π) chain, consist of the subunit [i. e., D(337), (225), T(337)] boundaries of Si(5 5 12)-2x1. The boundaries between D(337) and (225) and between T(337) and D(337) are honeycomb (H) chains, while the one between (225) and T(337) is a π chain. Initially, when Si is deposited on the Si(5 5 12)-2×1 surface held at 550 C, new π chains readily start to form on the D/A rows in the (225) subunit. In the present Si homoepitaxy at this temperature, it has turned out that only three kinds of equilibrium phases are possible. Those are, Si(5 5 12)-2x1 (Phase A), Si(7 7 17)-2x1 with two additional D(337)s (Phase B), and Si(7 7 17)-2x1 with one additional (225) and one additional (112) (Phase C). With extended Si deposition, these three phases commute among them in a peculiar fashion, that is, A⇄B ⇄C. These three phases are homogeneous on the whole Si(5 5 12)-2x1 surface, and their transformations with additional Si atoms are well explained by the new two-chain structural model. From the present homoepitaxy study at 550 C, it has also been confirmed that the normal reconstruction temperature, 900 C, in order to prepare the clean Si(5 5 12)-2x1 surface is high enough to give a unique reconstruction.