Idealized Growth Modes in Homoepitaxy

- step-flow
- layer-by-layer
- mound formation
- self-affine

Fig. 6.20
Growth on Pt(111) - Overview

Fig. 6.21
Absence of self-affine growth of Pt on Pt(111)

5 ML of Pt on Pt(111) deposited at 50 K (no diffusion possible). Image size 35 nm x 35 nm.

Fig. 6.22
Diffusion of Ir adatoms on Ir(111); imaging with field ion microscopy


Fig. 6.23
Diffusion of Ir adatoms on Ir(111)

Fig. 6.24


FIG. 6. Diffusivity of Ir adatoms on Ir(111), derived from mean-square displacement of a single atom at different temperatures.
Interaction Between Nucleation and Growth

Figure 5.5. Schematic illustration of the interaction between nucleation and growth stages. The adatom density \( n_1 \) determines the critical cluster density \( n_i^* \), however, \( n_1 \) is itself determined by the arrival rate \( F \) in conjunction with the various loss processes which have characteristic times as described in the text (Venables 1987).
Pt Islands on Pt(111)
Island Density as a Function of $\theta$ and $T$ for Pt Islands on Pt(111)

Island density as a function of coverage at 180 K

island density at coverage 0.1 ML

linear regression to STM data:

$$E_a = 0.26 \text{ eV}$$

M. Bott et al. PRL 76 (1996) 1304

Fig. 6.27
Step Edge - or Ehrlich-Schwoebel Barrier

\[ \nu' = \nu e^{-\Delta E_s / kT} \]

\[ \lambda \sim (v/F)^{1/6} \]

Fig. 6.28
The Zeno Model

vertical: \( v' = 0 \quad (v' \ll v) \)

\[ \frac{\partial \theta_n}{\partial t} = F(\theta_{n-1} - \theta_n) \]

analytic solution:
\[ \sigma = h^{0.5} \]
\[ \lambda = \text{const.} \]
shape


Fig. 6.29
Nucleation on Top Terrace and Mound Profile for Finite Barriers

shape analysis:

\[ \nu' = \nu_0 \frac{3}{5} \Delta \nu \]

\[ E = 0.18 \text{ eV} = 7 \times 10^{-11} \text{ s} \]

\[ S = 3.1 \text{ F L} \]

Poisson profile

Fig. 6.30
Reading Atomistic Parameters from the Morphology

Fig. 6.31
Zeno-Effect

\[ \dot{x}(t) = -F \cdot x_0 \]

\[ x(t) = x_0 (1 - F \cdot t) \]

\[ x(t) = x_0 e^{-F \cdot t} \]

\[ x(\frac{n}{F}) = x_0 e^{-n} \]

\[ d(n) = d_0 10^{-3n} \]


Fig. 6.32
Examples

10 ML 300 K
3000 Å

25 ML 420 K, CO
3200 Å

300 ML 440 K
3500 Å

≈ 19 ML pentacene on amorphous substrate
40000 Å

Fig. 6.33
Pulsed ion assisted homoepitaxy on Pt(111)

400 K, 5ML

2130Å

no ion pulses

4 keV Ar\(^+\) ion pulses in ML-timing, fluence each 0.003 ML


Fig. 6.34