Asymmetric shape transitions of epitaxial quantum dots from pyramid to multifaceted dome
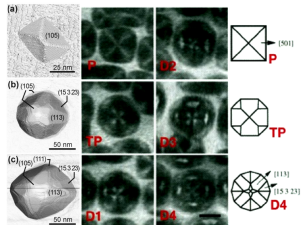
- Stranski-Krastanov mode
  - Planar film becomes unstable due to the misfit between film and substrate
  - Self-assembled quantum dots form

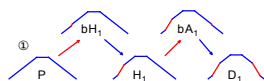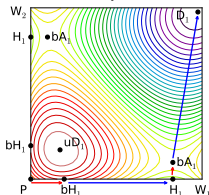- Shape transitions of strained islands during growth

Sutter *et al.* (2005), Ross *et al.* (1999)

- Construct a 2D model for fully-faceted islands
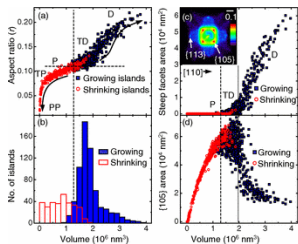- The total energy of an island $h(x)$

$$E = \gamma \int (\sqrt{1 + h_x^2} - 1)dx +$$
$$S_0 \int [-2hH(h_x) + 4hH^2(h_x) - 4hh_x^2]dx$$

- Minimize the total energy with fixed volume to find the equilibrium shape

- Calculate energy surface and find lowest-barrier transition path

Evolution of island shape distribution including asymmetric shape

- Bimodal distribution of pyramids and domes

Rastelli *et al.* (2005)

- Growth process: Fokker-Planck equation
- Transition process: Reaction equation
- Coupling Fokker-Planck equation with transition terms
- Distribution is determined by growth rate, transition rate and deposition rate.
- Two regimes:
  - ▶ fast growth: more half dome during transition and resulting unimodal distribution
  - ▶ slow growth: fewer half dome during transition and resulting bimodal distribution