Some Examples
Gradual graphitization of SiC, as indicated by the shrinking of the 6√3 region (decorated by high density Co-clusters) as the surface is heated.

The surface fraction converted to graphene is analyzed and Kinetic Model for growth is thus developed.

\[ C_{(6\sqrt{3})} \xrightarrow{k_a} C^* \xrightarrow{k_b} C_G \]

\[
\frac{d[C^*]}{dt} = k_a C_{(6\sqrt{3})} - k_a C^* - k_b C^* - k_b C[G]
\]

\[
[C^*] = \frac{k_a C_{(6\sqrt{3})}}{k_a + k_b} \frac{d[C_G]}{dt} = k_a C_{(6\sqrt{3})}
\]

Treating \( [C_{6\sqrt{3}}] \) as a fraction of the area terminated with 6√3 and \( [C_{6\sqrt{3}}] = 1 - [C_G] \), we have

\[
\ln(1 - C_G) = -k_a t
\]

\( E_a \) is found to be 3.0 ± 0.4 eV, the breaking Si–C bond (~3.3 eV) is the rate-limiting step in the formation of graphene.
STM: Surface Morphology, Structure, Growth Mode, Nucleation Dynamics, Kinetics and Critical Nucleus Size on Gp-IV Surfaces

3D Growth Mode
Cobalt clusters seen on (a) HOPG, (b) Epitaxial Graphene and (c) $6\sqrt{3}$ surface on 6H-Silicon Carbide. Size distributions of Co clusters on HOPG, EG and $6\sqrt{3}$: (a)–(c) volume distributions of Co clusters sampled from coverages in the pre-coalescence regime; and (d)–(f) distributions of cluster width against their height.

Scaling Analysis
Critical Nucleus Size, $i^*$
Smallest Stable Cluster, $i^*+1$
STM: Observing Real Time Self Assembly Dynamics Of Magic Clusters

Existence of a Configuration Dependent Critical Nuclei, $i^* = 6$, in promoting the Self Assembly of Co-Si Magic Clusters, life-time of 5s at 400°C
STM: Si “Magic” Cluster Mediated Phase Transformation On Si(111) Surface

Surface phase transformation to form ordered (7 × 7) reconstruction from disordered “1 × 1” phase occurs on the Si(111) Surface. The dynamic process is mediated by the formation of Si magic clusters of size ~ 13.5 ± 0.5 Å.

Using real time STM scanning to probe the surface at ~ 400 °C, Si magic clusters were found to “pop-out” and form spontaneously from the disordered “1 × 1” phase.

The difference in atomic density between “disordered 1 × 1” and (7 × 7) surface structures, drives the release excess Si adatoms onto the surface as Si magic clusters.
Physisorbed carbon species (C–C/C–H) and O$_2$ state desorbs at 100°C. Chemisorbed O–C=O and O–C species desorbs above 200 °C. A reduction of Fe$_2$O$_3$ into Fe$_3$O$_4$ occurs. At 400°C, desorption of carbon and O–C/O–C=O/O$_2$ species in O1s occurs. Fe$_3$O$_4$ (sample 1) was reduced into FeO by excess metallic Fe from the bulk, while Fe$_3$O$_4$ (sample 2) was oxidized into Fe2O3 by the oxygen from the bulk of Fe$_2$O$_3$. Exposure to air after heating, the same chemical states associated with C and O species were detected again.
Ni deposited on H-terminated Si(001) surface at RT as a function of Ni coverage. Ni 2p 3/2 spectrum from bulk Ni foil and Si 2p spectrum from pure H-Si(001).

(a) XPS valence band (VB) spectra of Ni grown on H-Si(001) (b) Difference curves for Ni VB with emission from Silicon subtracted. Stacking of these curves (inset) shows that the Fermi edge shifts gradually to that of bulk Ni.

Results:
Pseudo-layer-by-layer growth mode. Formation of interfaces between bulk-Si(001)/NiSi-like/Ni-rich-silicide-like/metallic Ni in the structure as growth proceeds.
XPS: Band-Energy Alignment at III-V/IV Semiconductor Heterojunctions

Results:

In$_{0.49}$Ga$_{0.51}$P/Ge(100) interface has a Type-I Band Alignment

TEM and EDX of the In$_{0.49}$Ga$_{0.51}$P epilayers on Ge (100). The EDX show a sharp In$_{0.49}$Ga$_{0.51}$P/Ge interface with an In$_{0.49}$Ga$_{0.51}$P layer thickness of 2 nm.