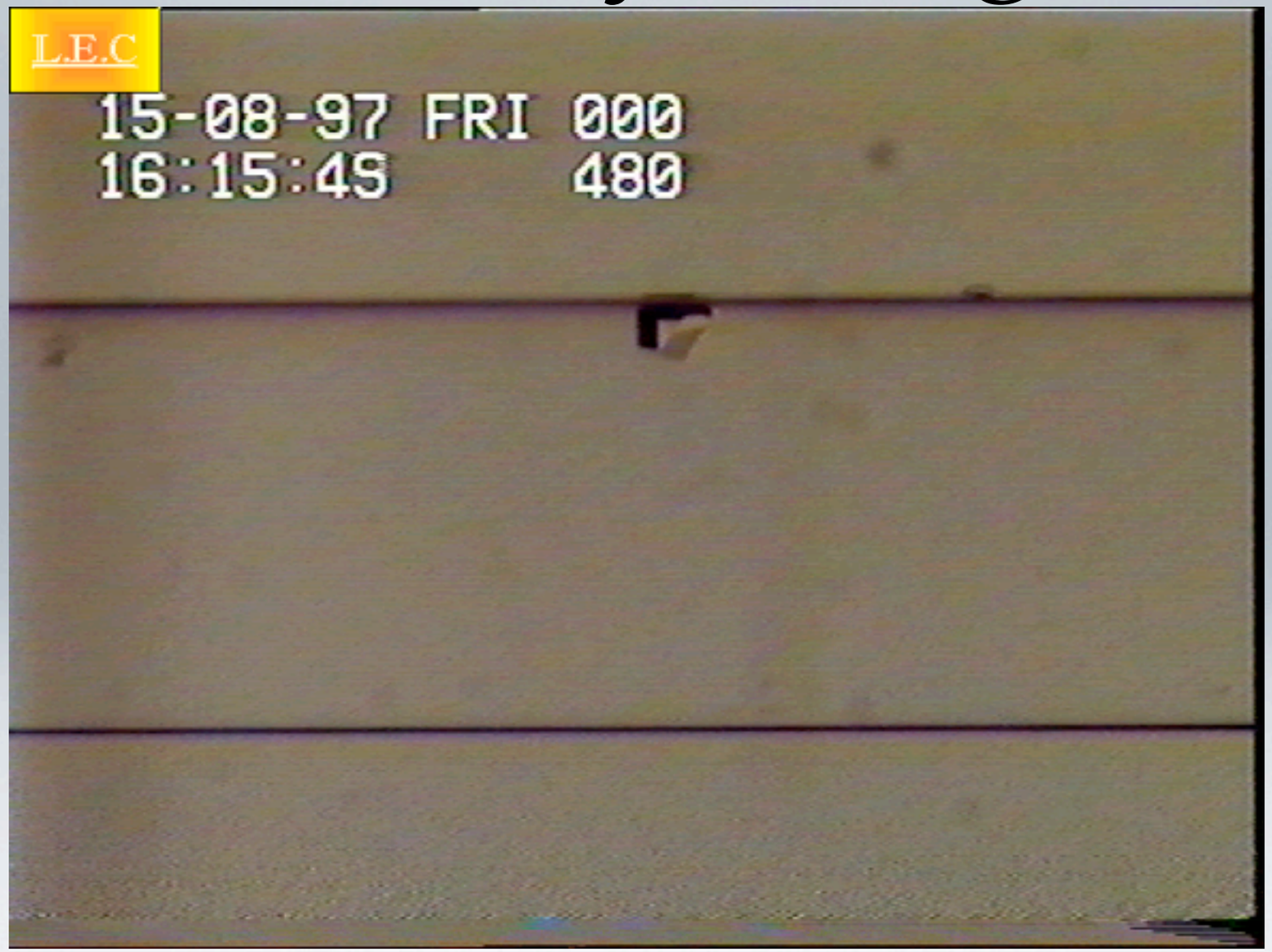
Crystal Growth Mechanisms
How do crystals grow?

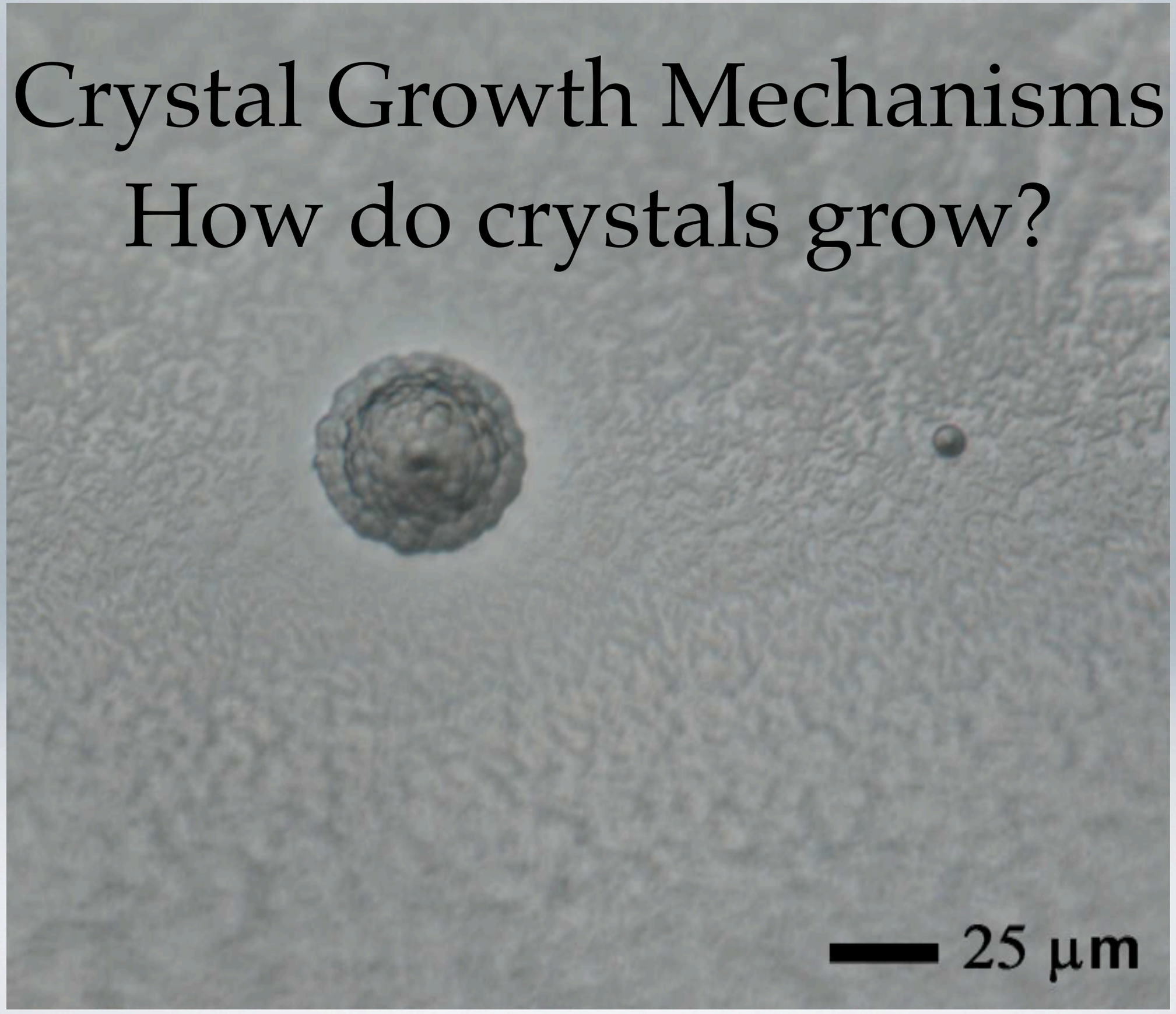
Juan Manuel García-Ruiz
CSIC-Universidad de Granada

Crystal Growth Mechanisms
How do crystals grow?



Juan Manuel García-Ruiz
CSIC-Universidad de Granada

Crystal Growth Mechanisms
How do crystals grow?



Los cristales crecen por acumulación de unidades de crecimiento (UC)

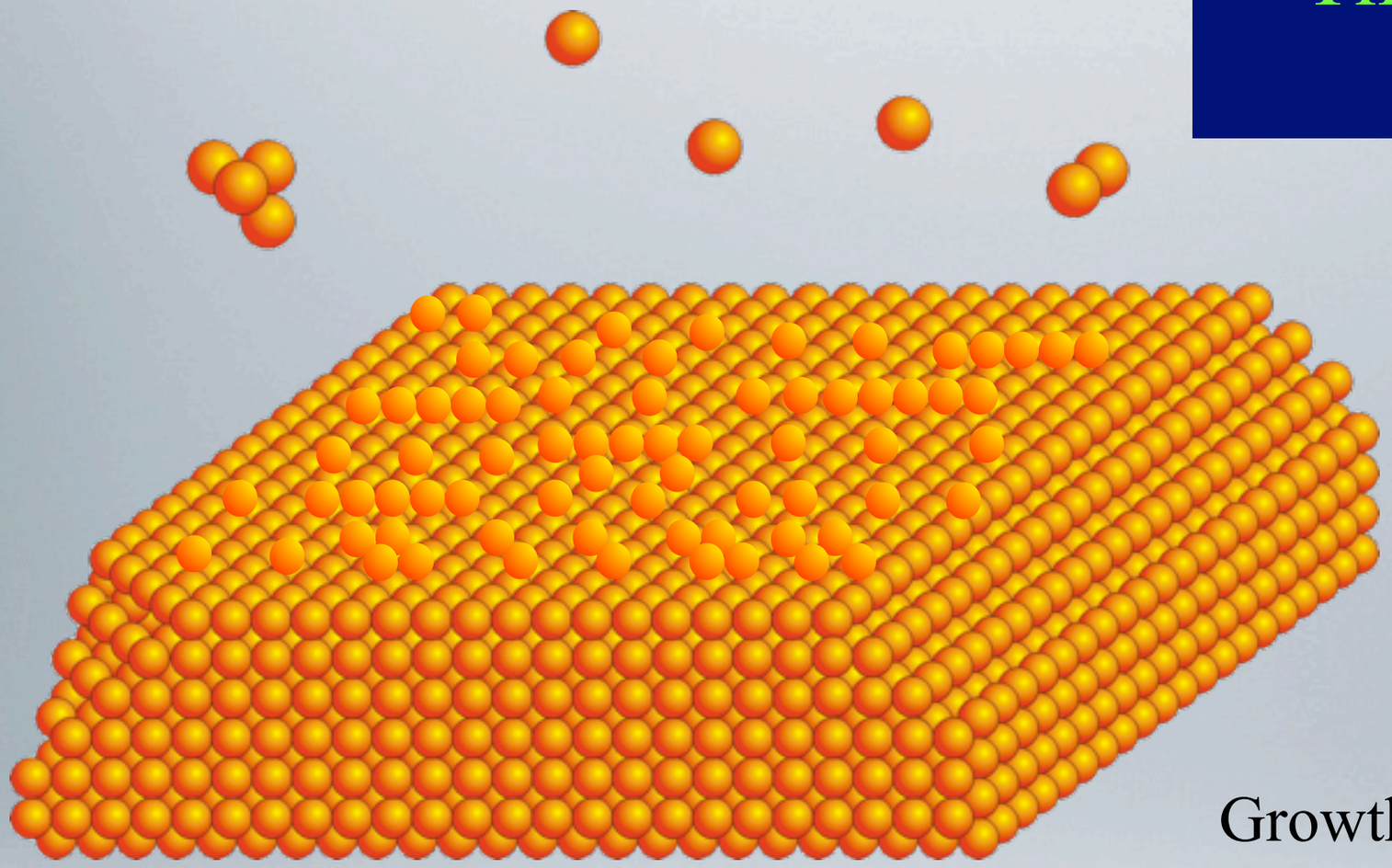
Las UC pueden ser átomos, especies aniónicos o polianiónico, o sus agrupaciones

Las UC se acumulan sobre el cristal por diferentes mecanismos

Los mecanismos de crecimiento pueden funcionar simultaneamiente, por lo que el mecanismo más rápido domina la tasa de crecimiento overal

Crystal Growth Mechanisms
Normal Growth
(Direct Accretion)

The growth of a rough crystal surface

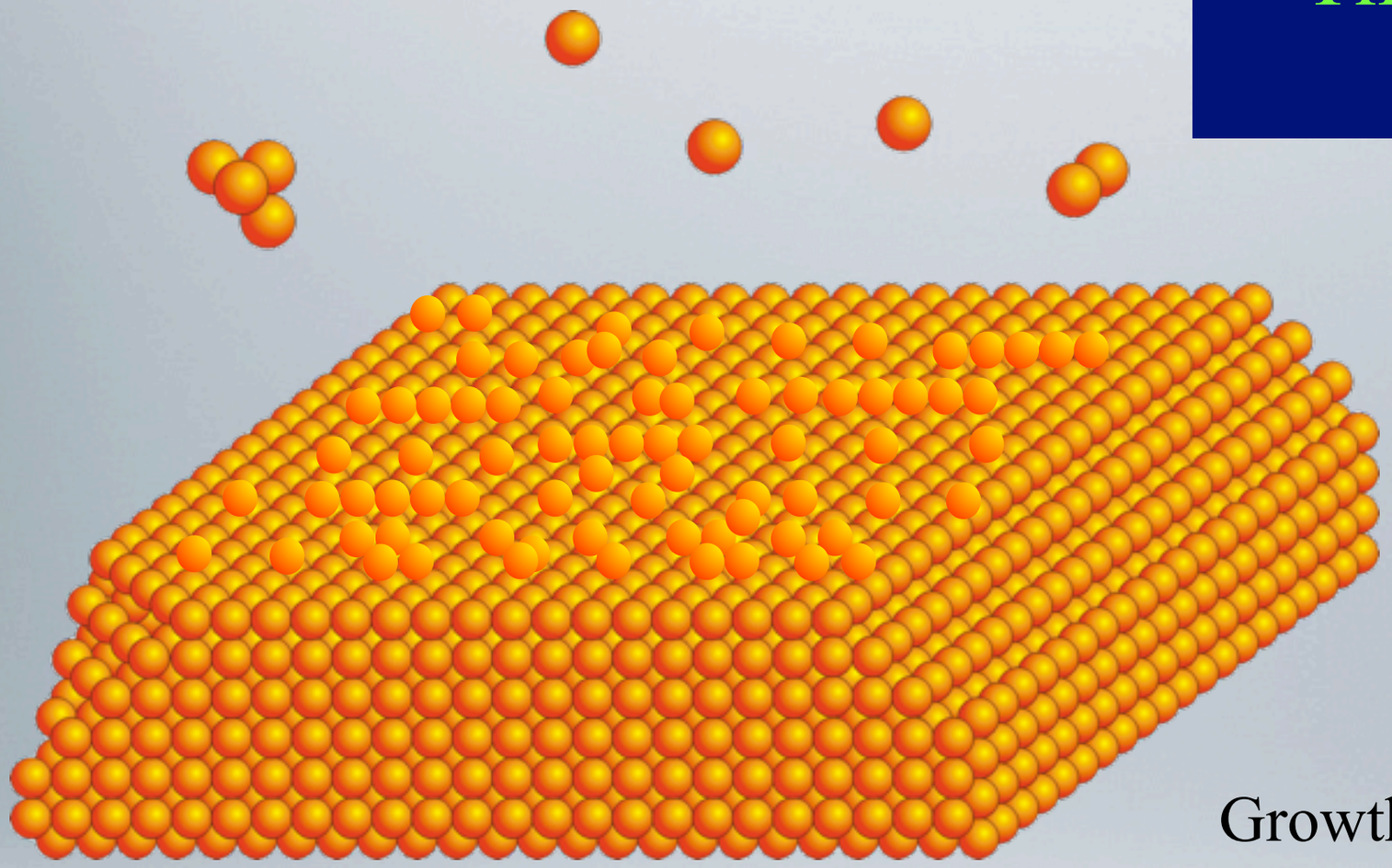


Growth by direct accretion:
Normal growth

$$R_g = k(\sigma - 1) = k\beta$$

Linear trend with supersaturation

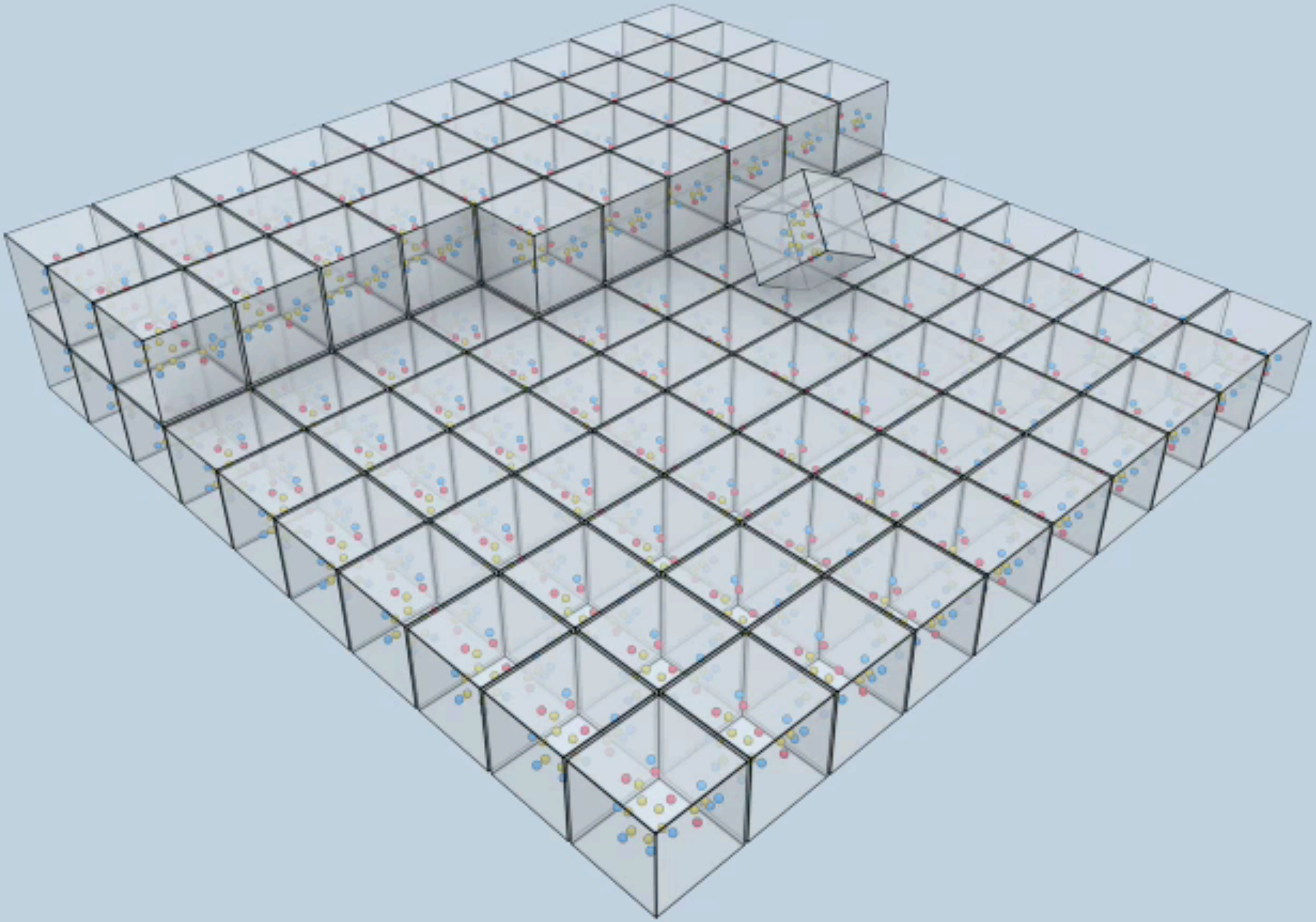
The growth of a rough crystal surface

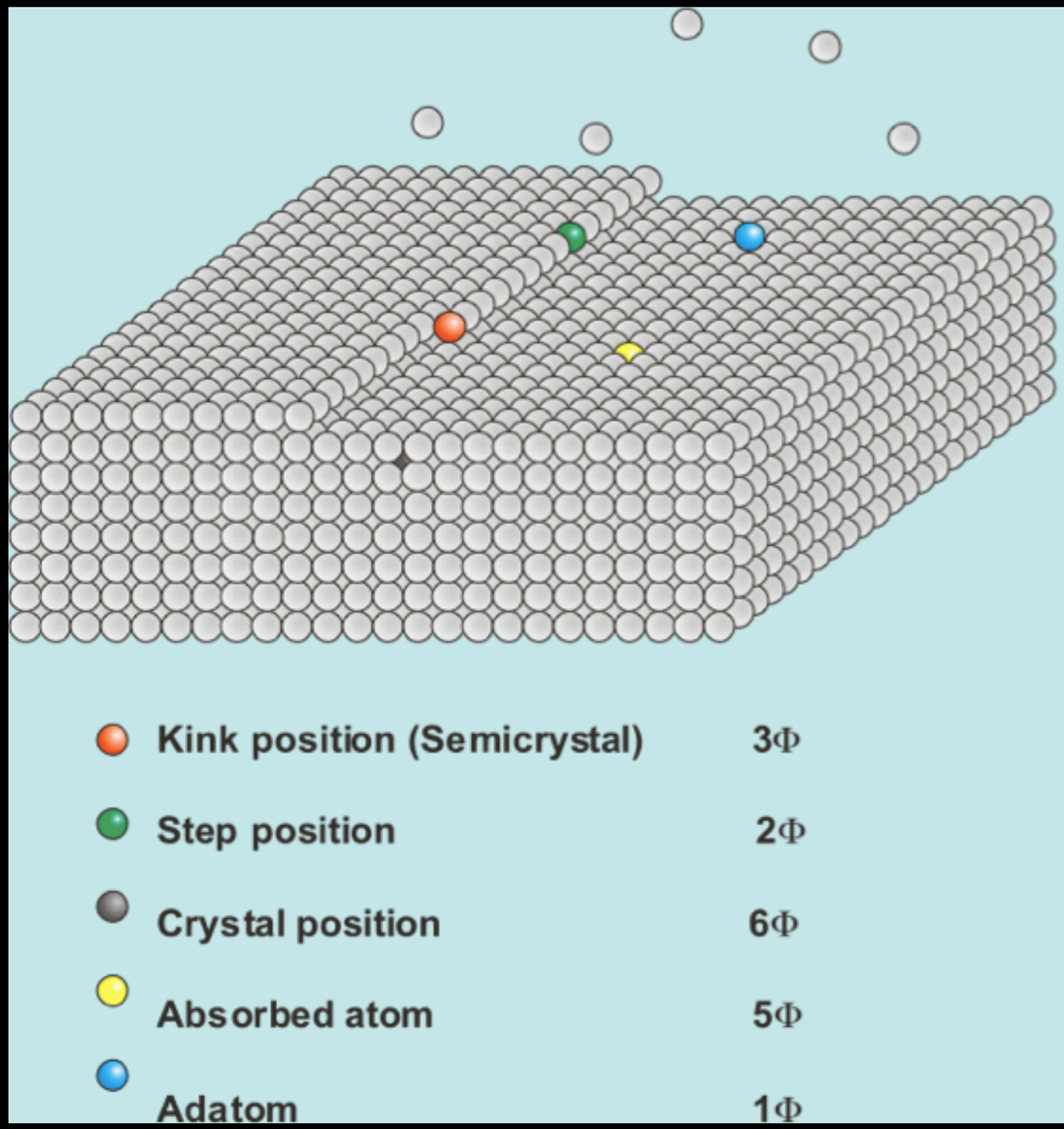


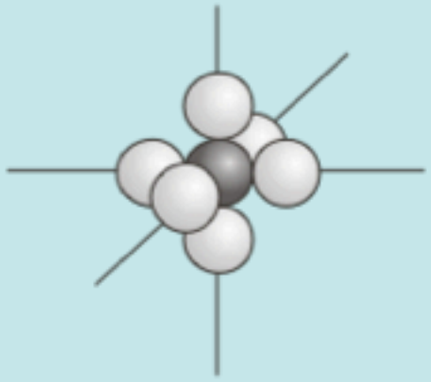
Growth by direct accretion:
Normal growth

$$R_g = k(\sigma - 1) = k\beta$$

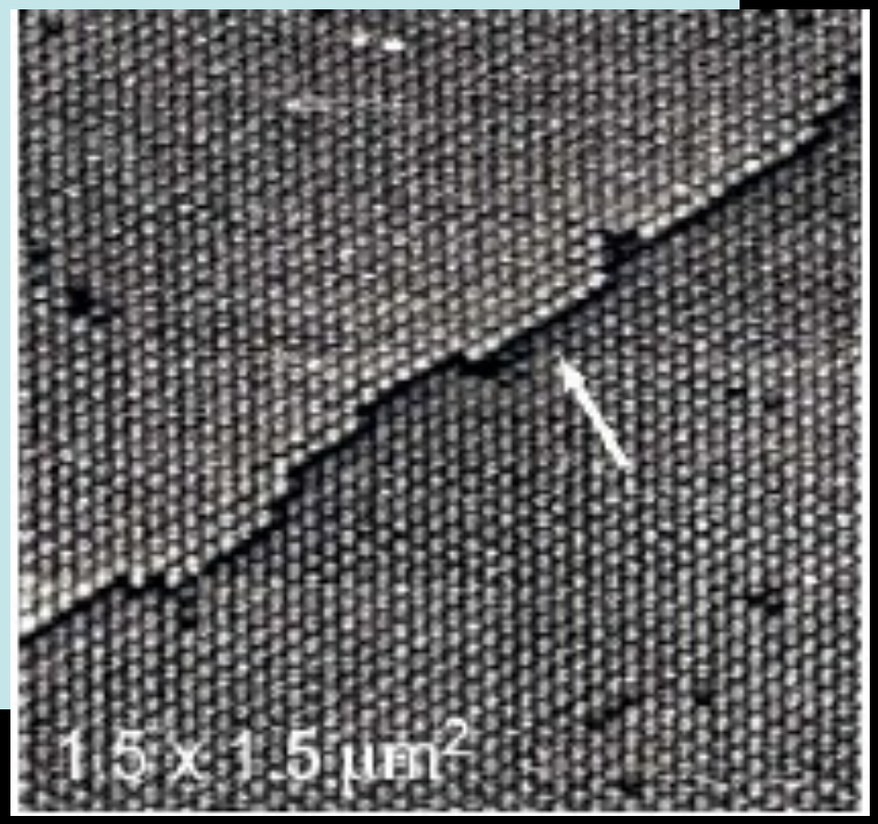
Linear trend with supersaturation

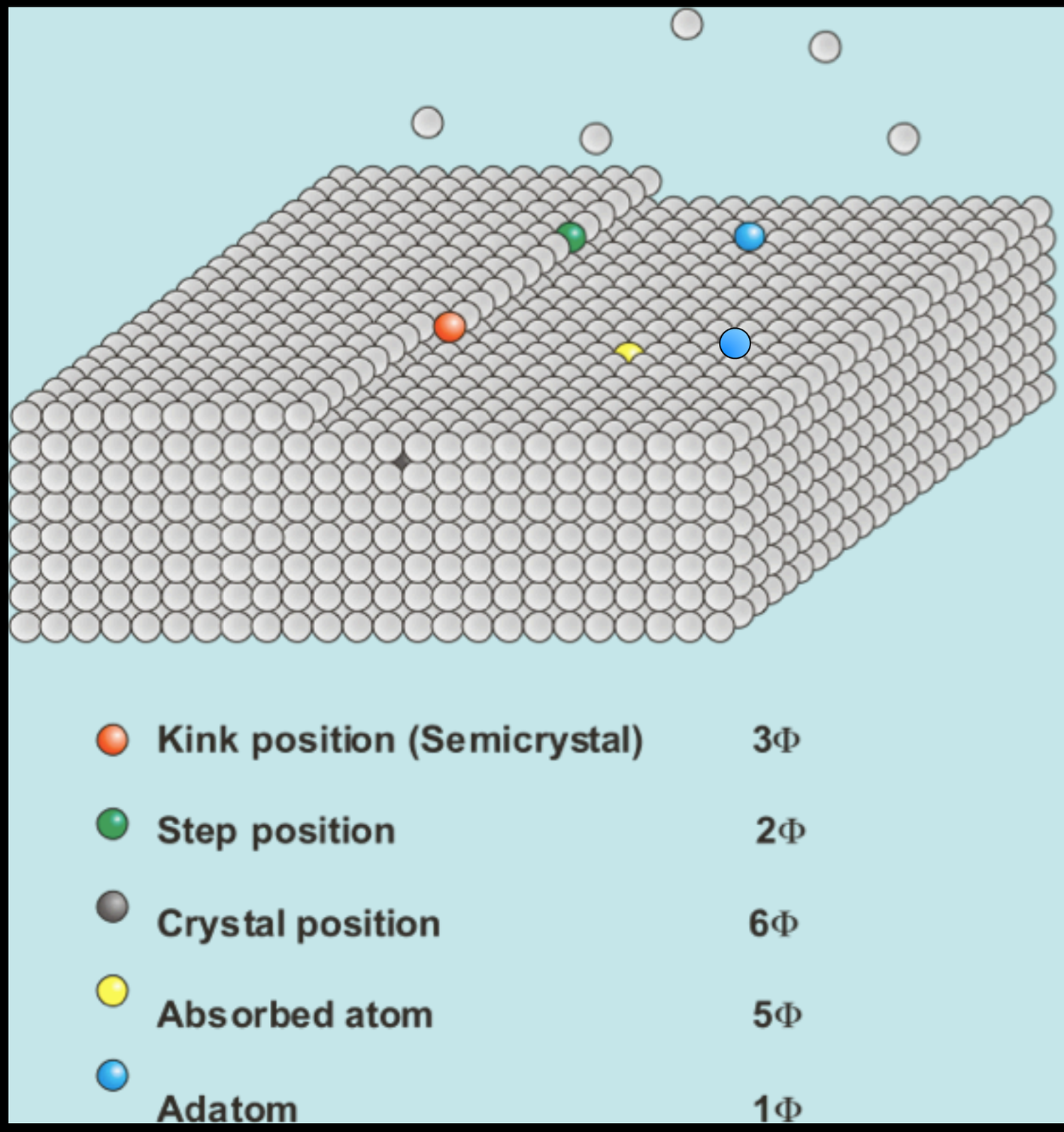


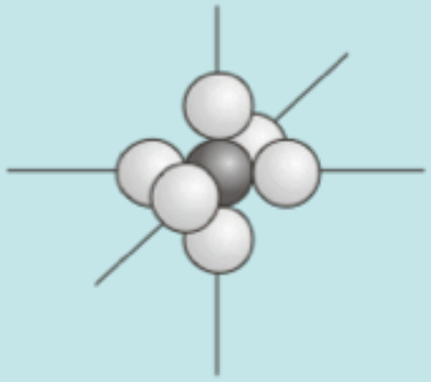




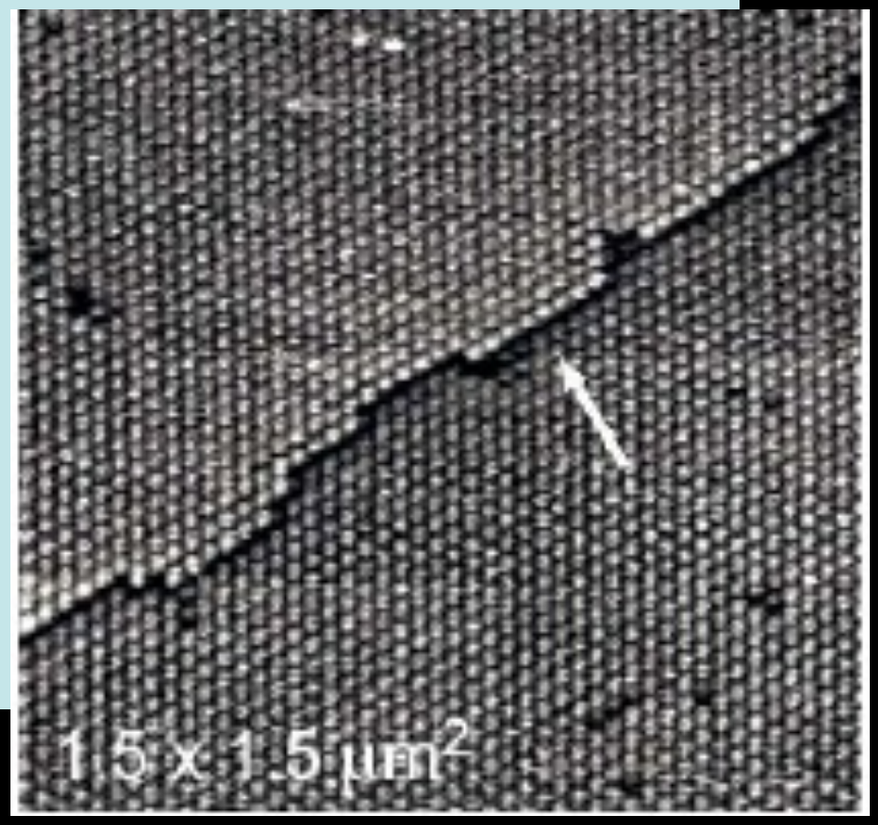
Bonding configuration

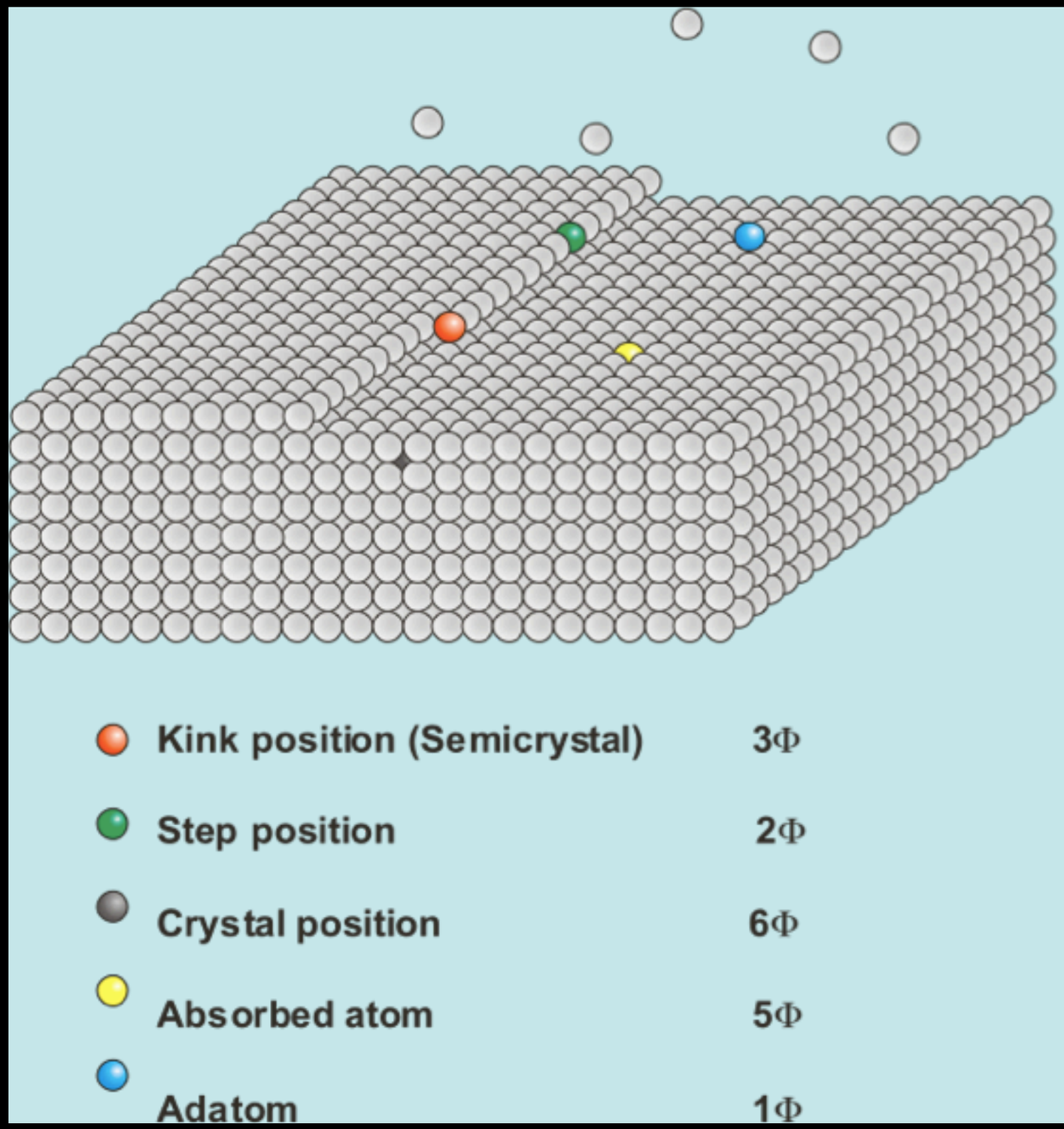


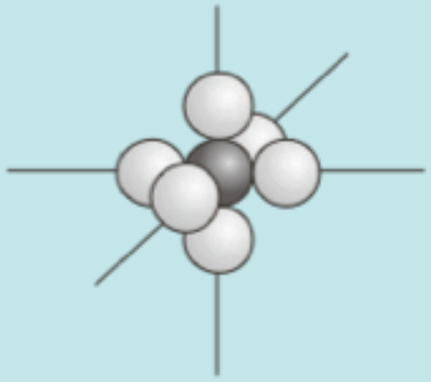




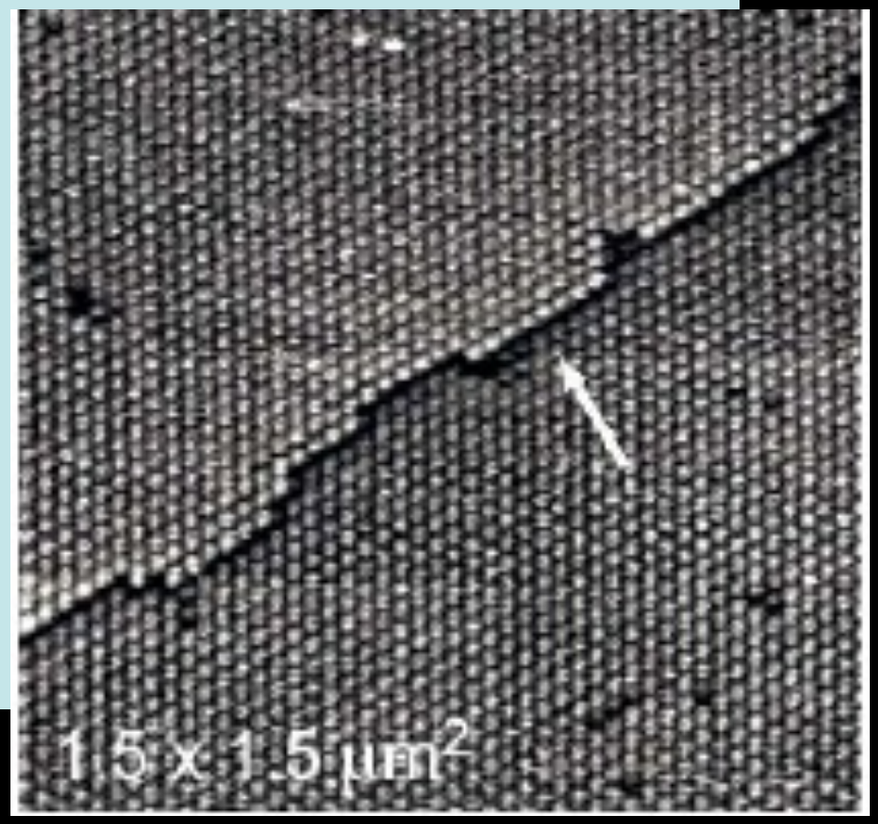
Bonding configuration

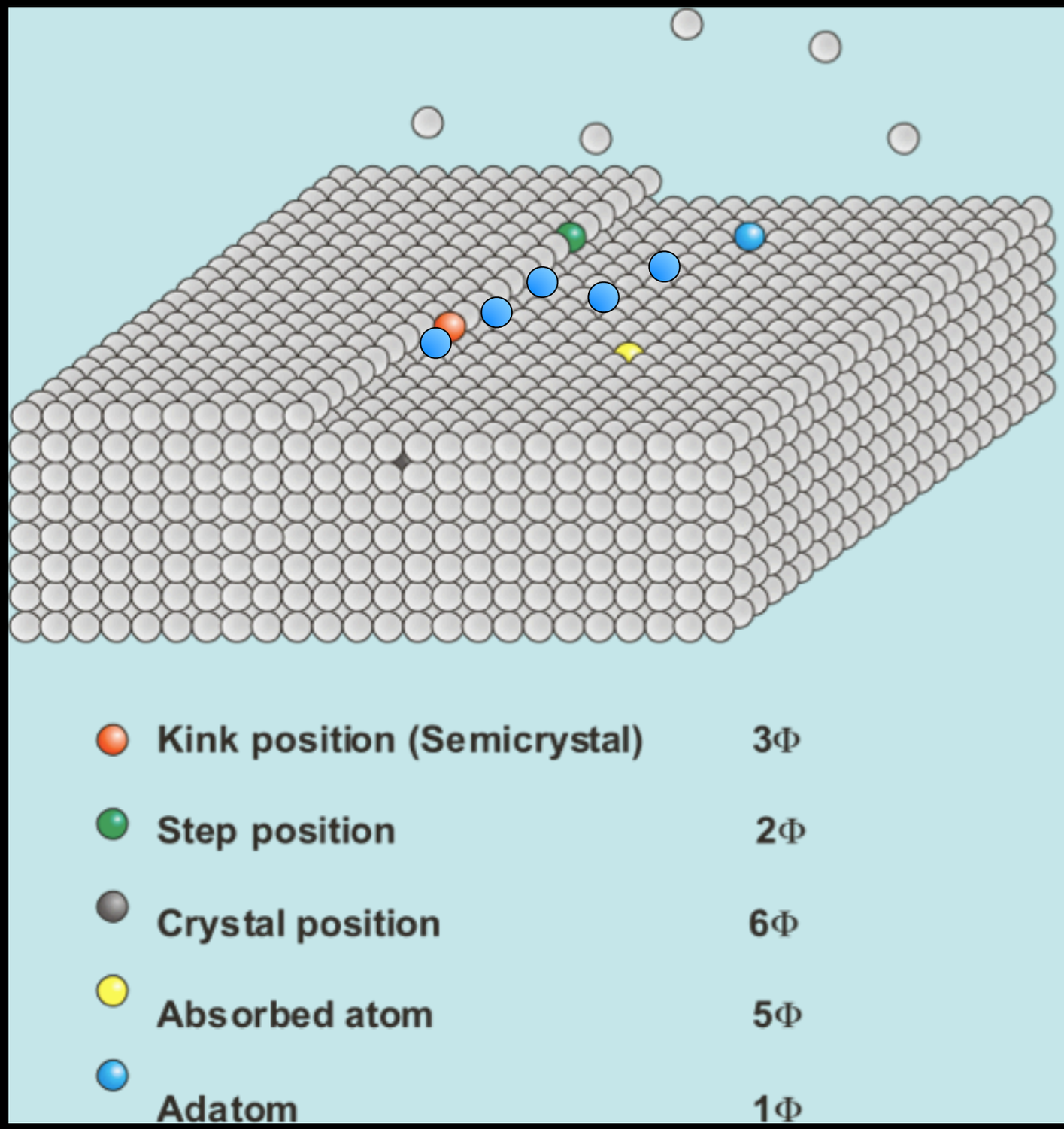


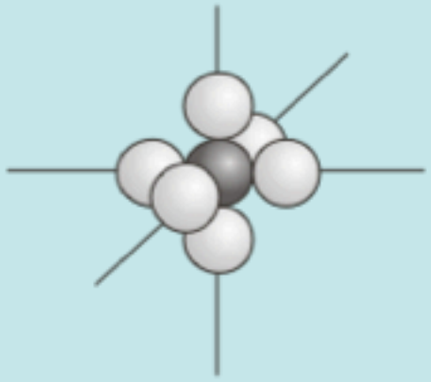




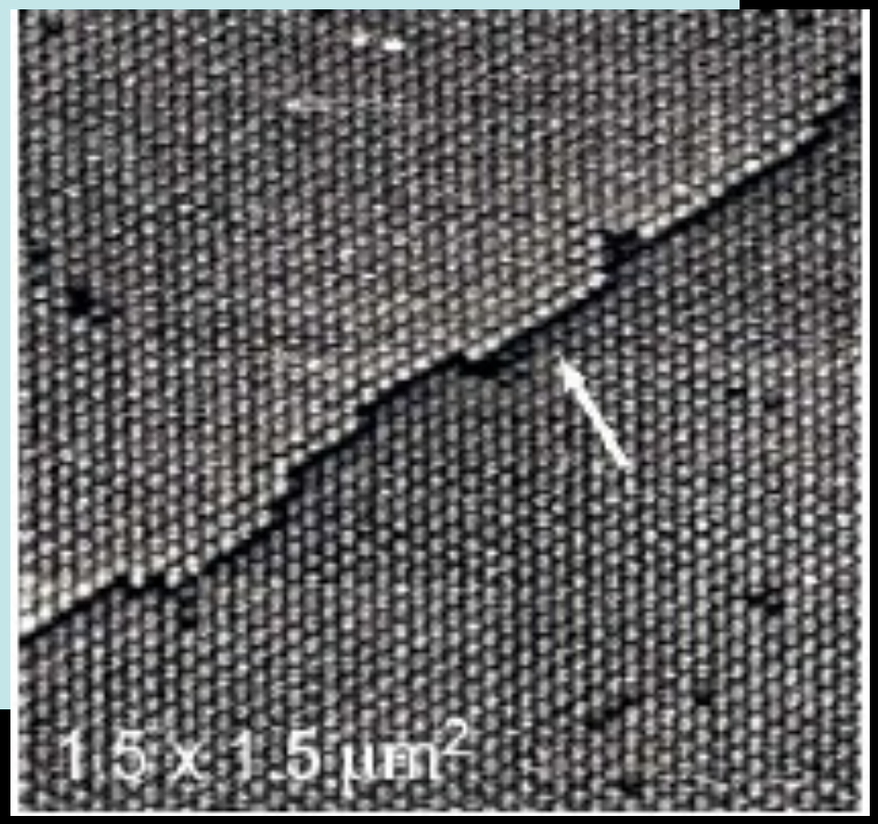
Bonding configuration

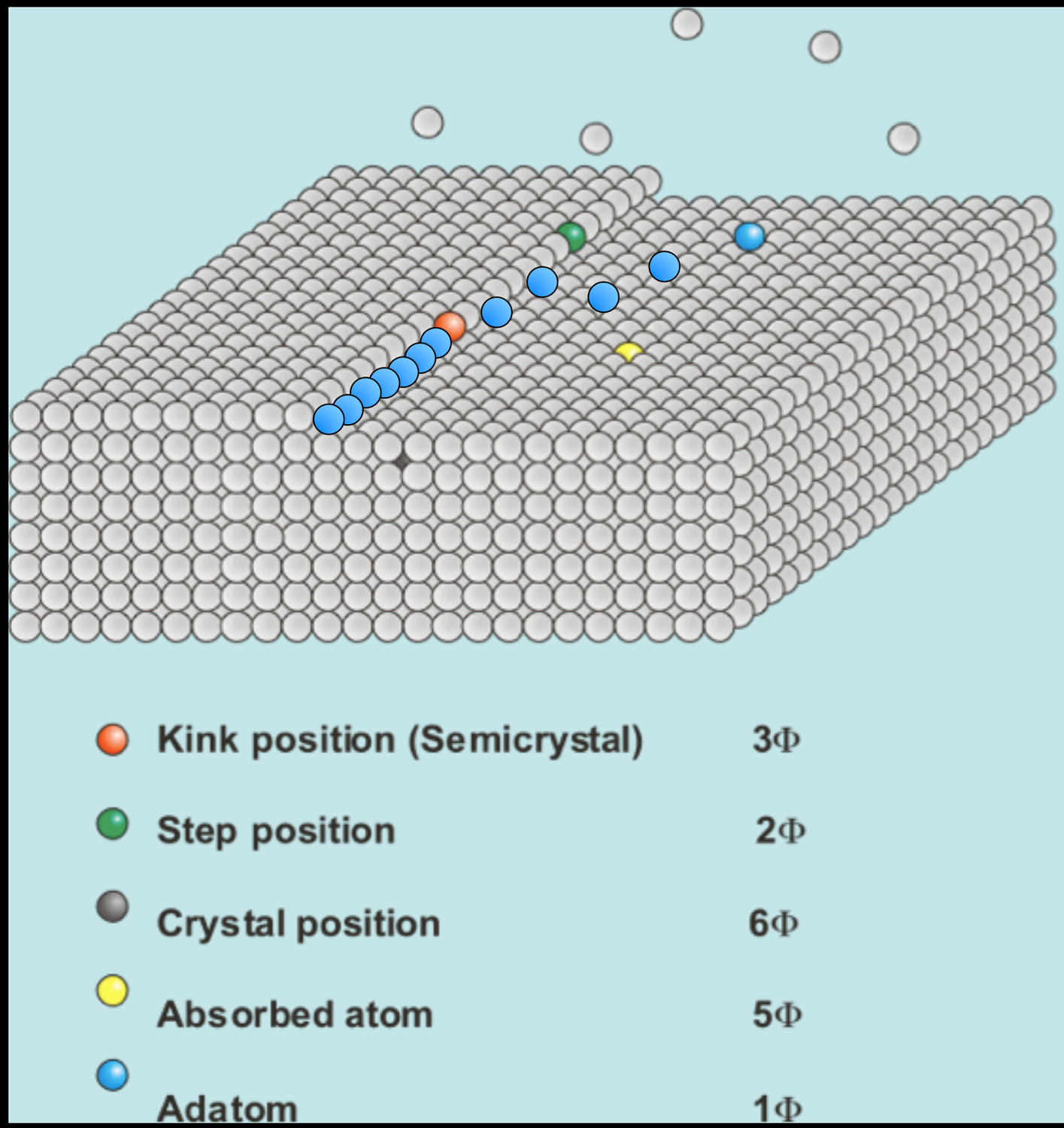


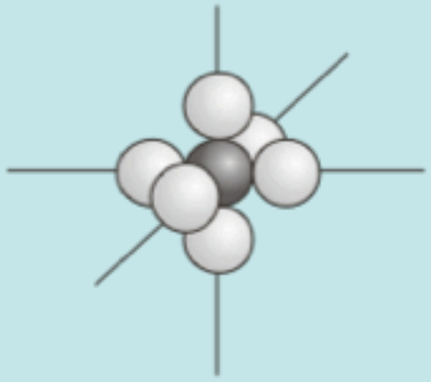




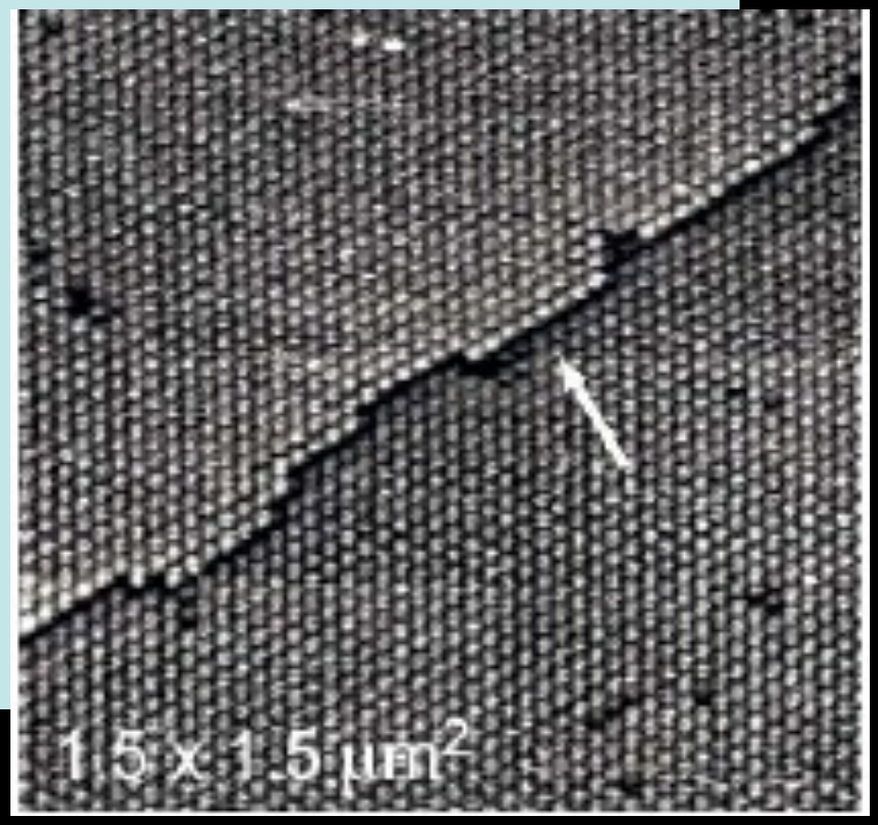
Bonding configuration

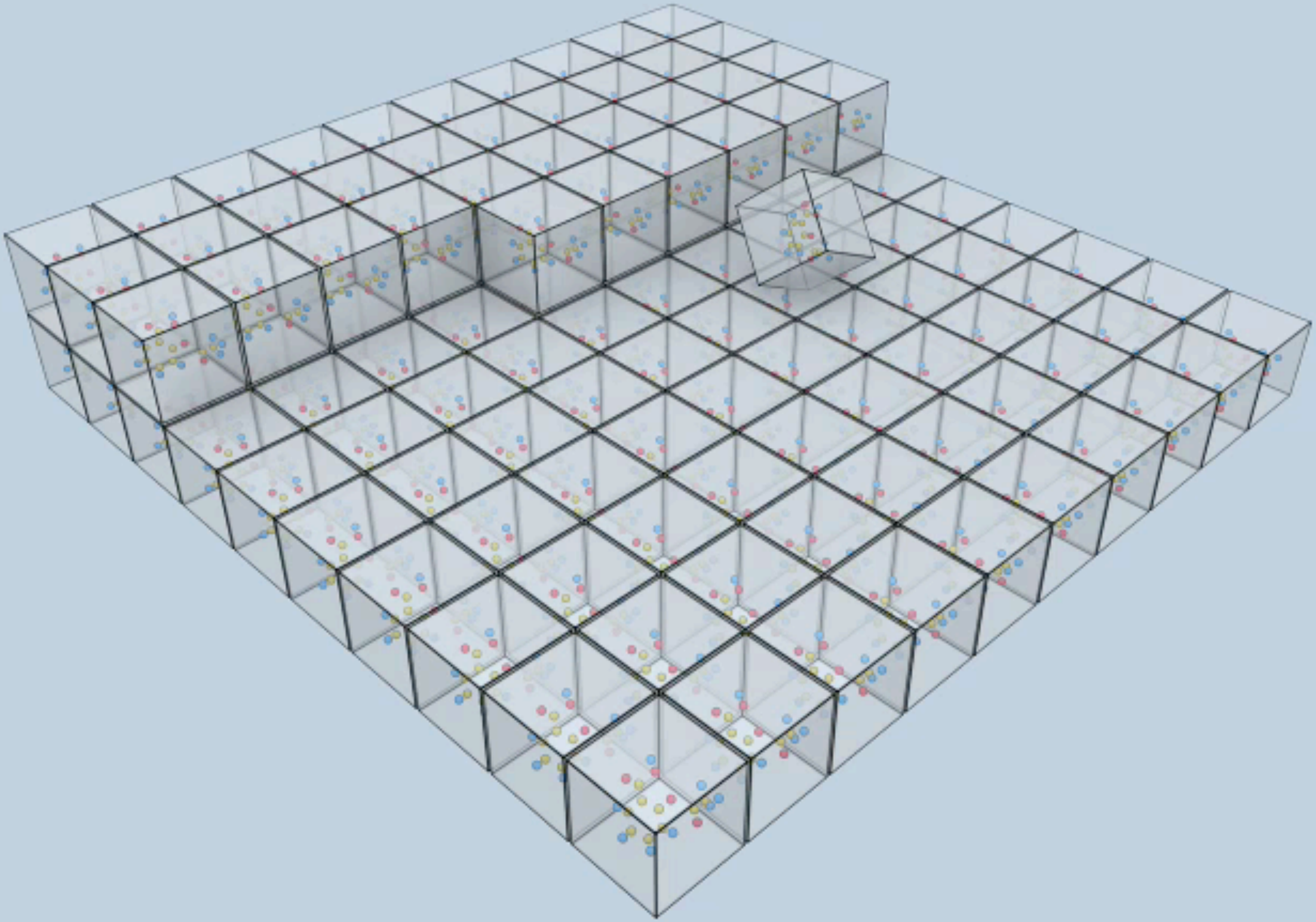


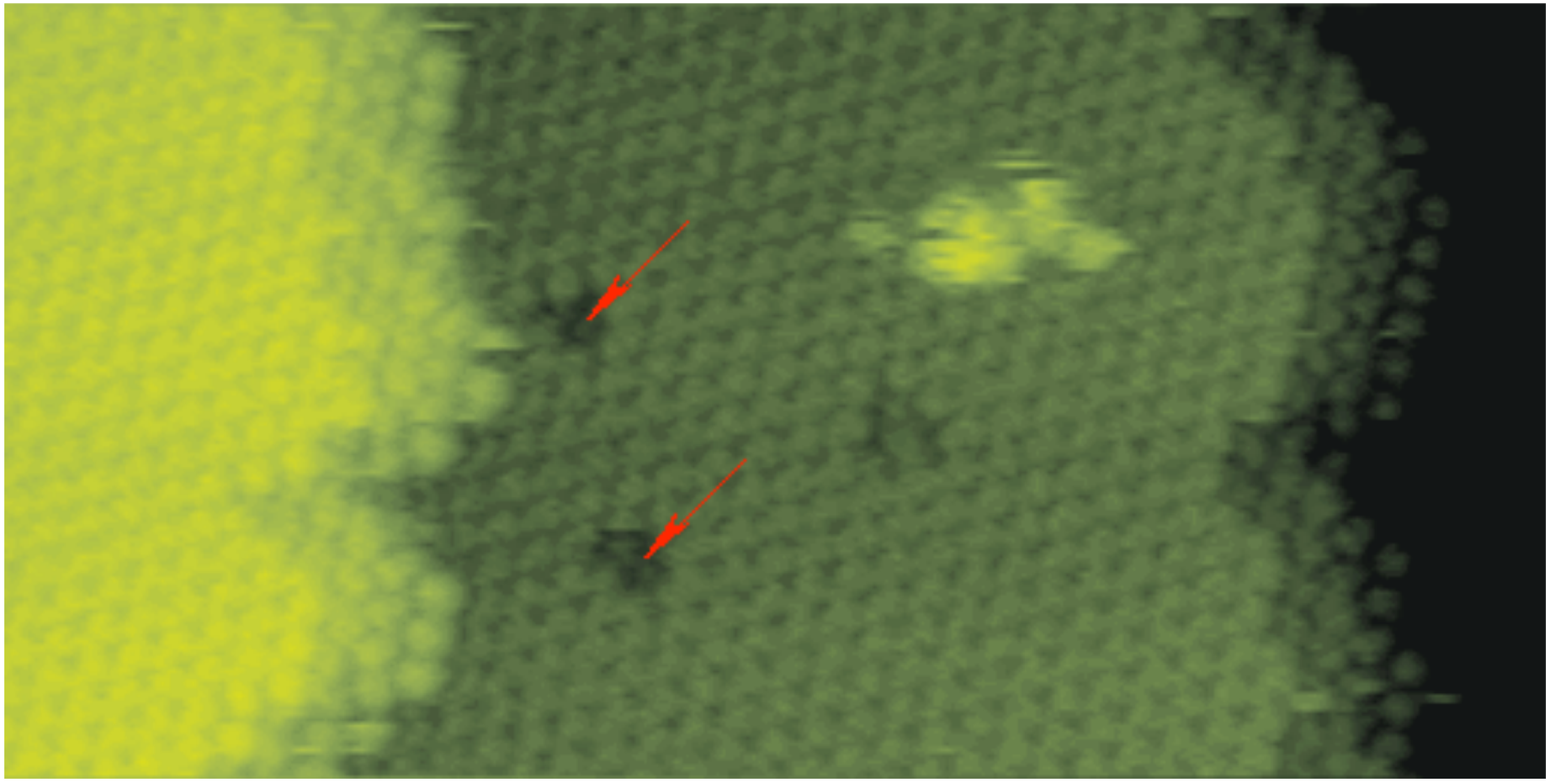




Bonding configuration







Movie provided by Vekilov and Georgiou

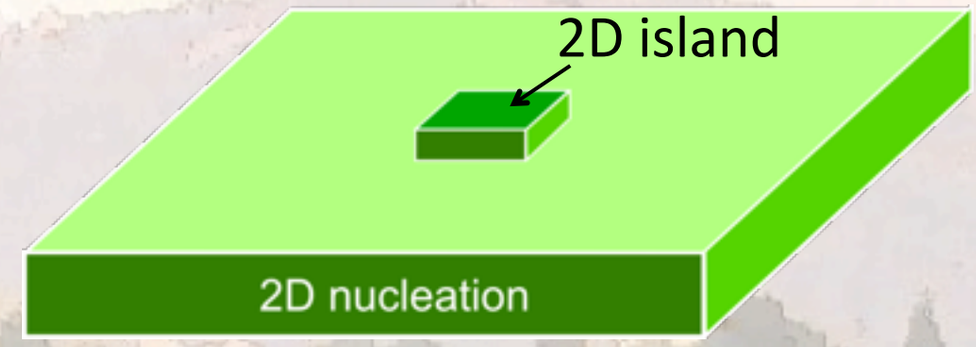
Crystal Growth Mechanisms
Two-dimensional nucleation

(Birth and Spread growth)

So what happens on perfect flat faces?

(Birth and Spread growth)

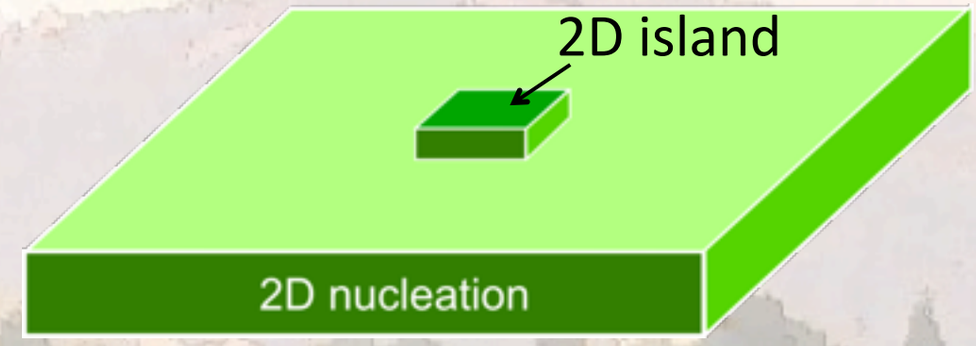
So what happens on perfect flat faces?



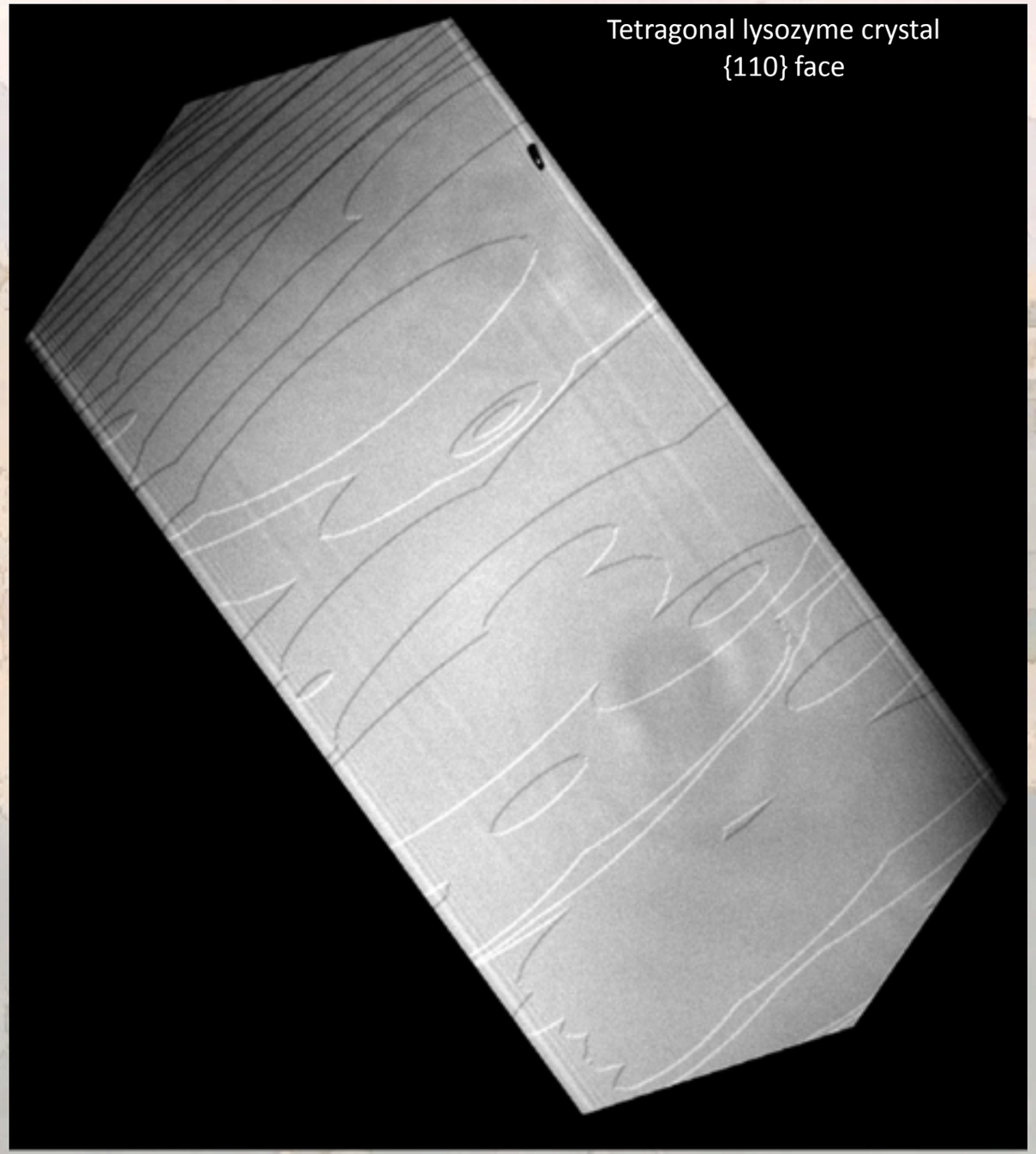
Steps are created by a process of two-dimensional nucleation: (≈3D nucleation)

(Birth and Spread growth)

So what happens on perfect flat faces?

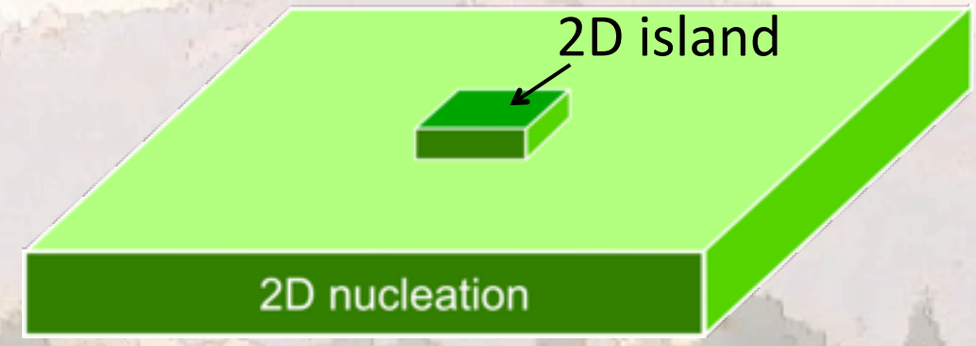


Steps are created by a process of two-dimensional nucleation: (≈3D nucleation)



(Birth and Spread growth)

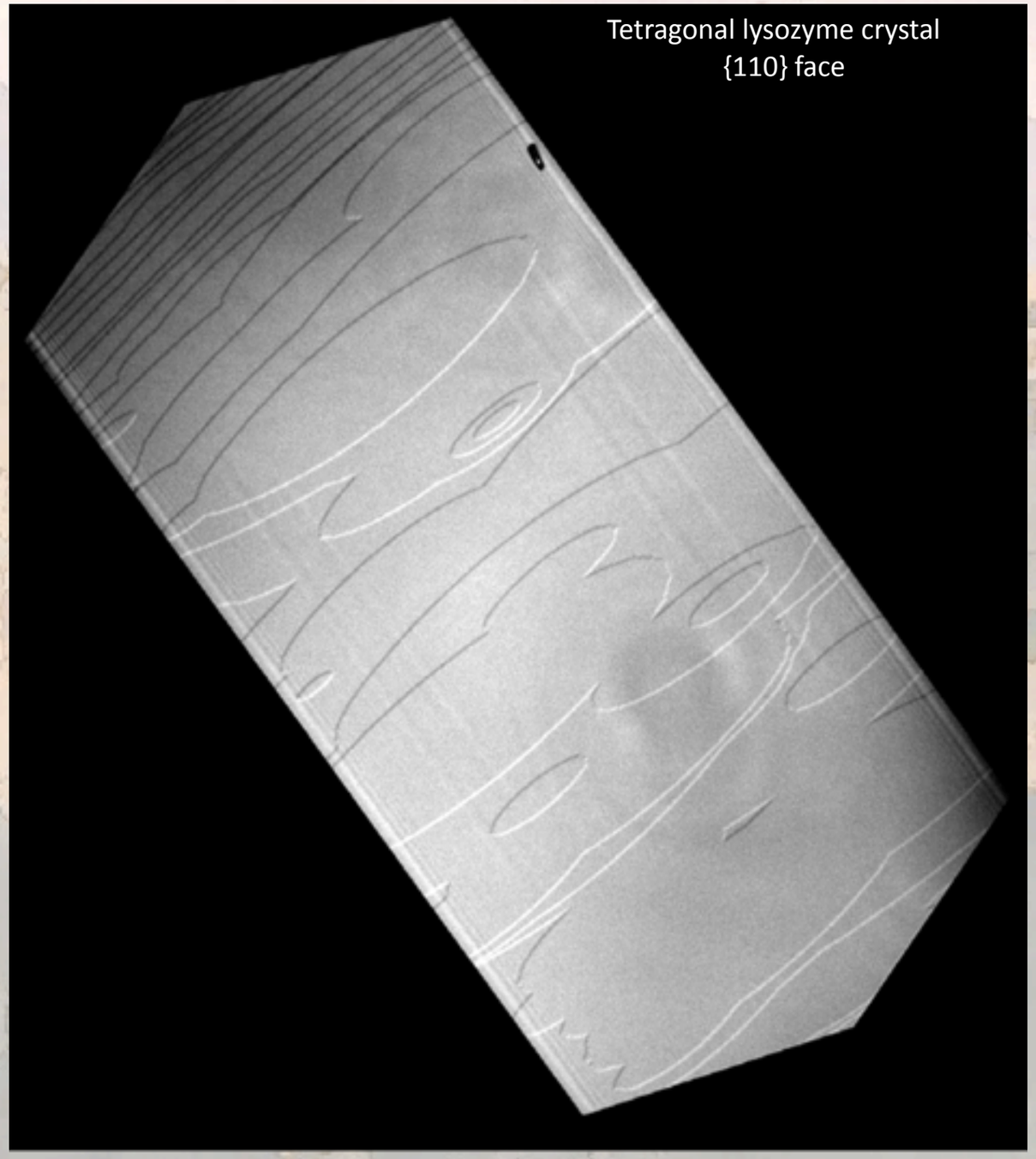
So what happens on perfect flat faces?



Steps are created by a process of two-dimensional nucleation: (≈3D nucleation)

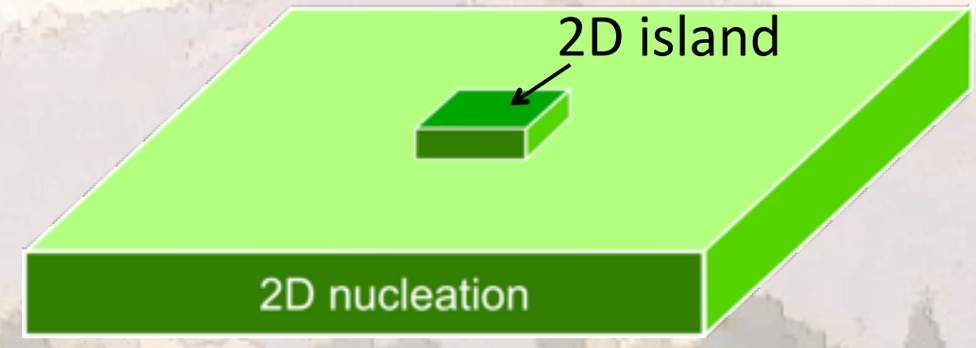
→ Nucleation barrier is involved

→ Mininum supersaturation is required



(Birth and Spread growth)

So what happens on perfect flat faces?

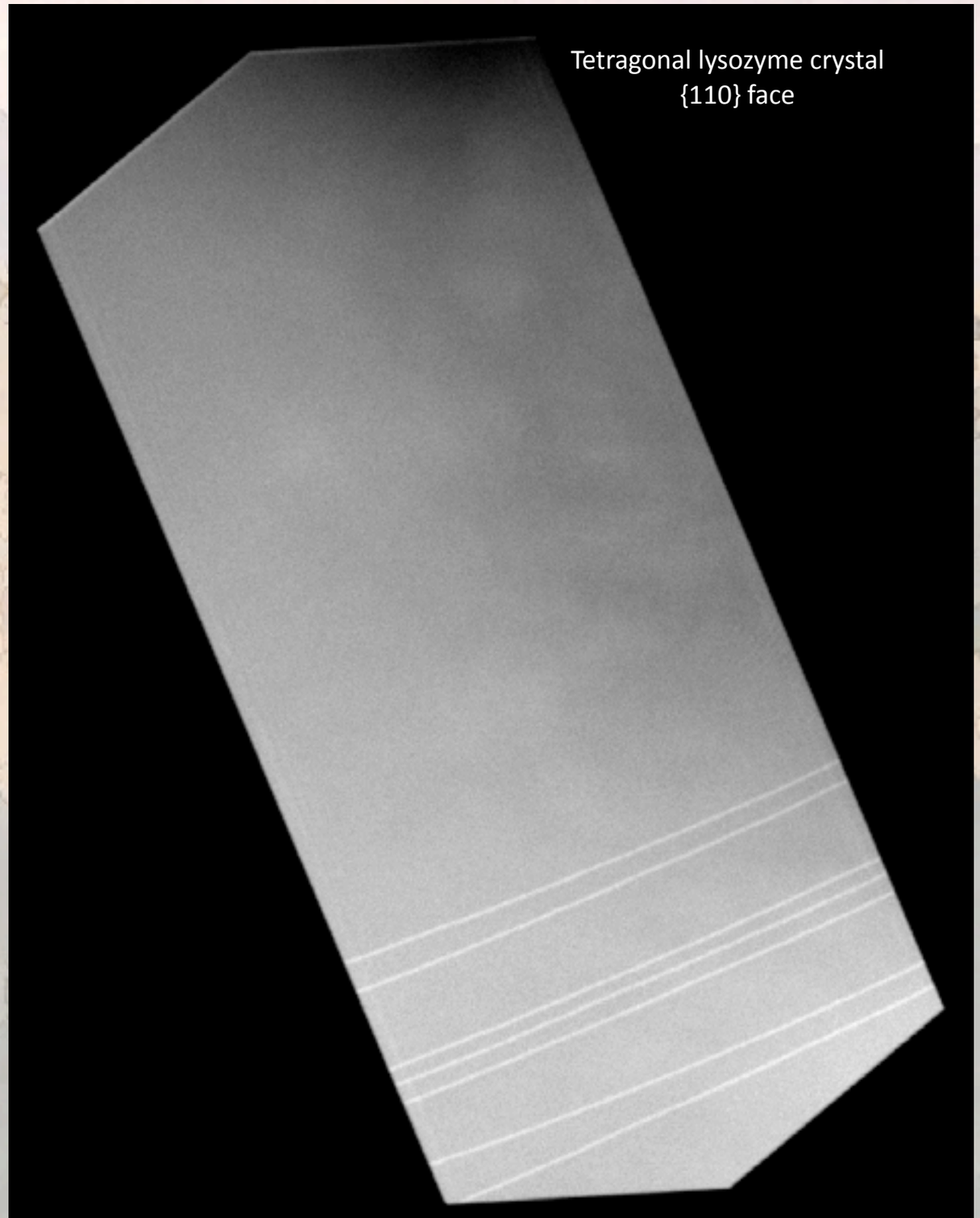


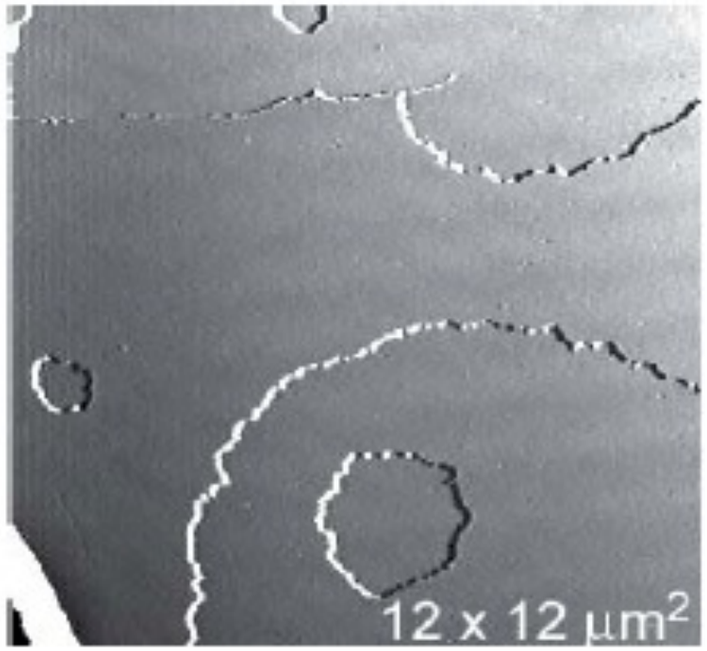
Steps are created by a process of two-dimensional nucleation: (≈3D nucleation)

→ Nucleation barrier is involved

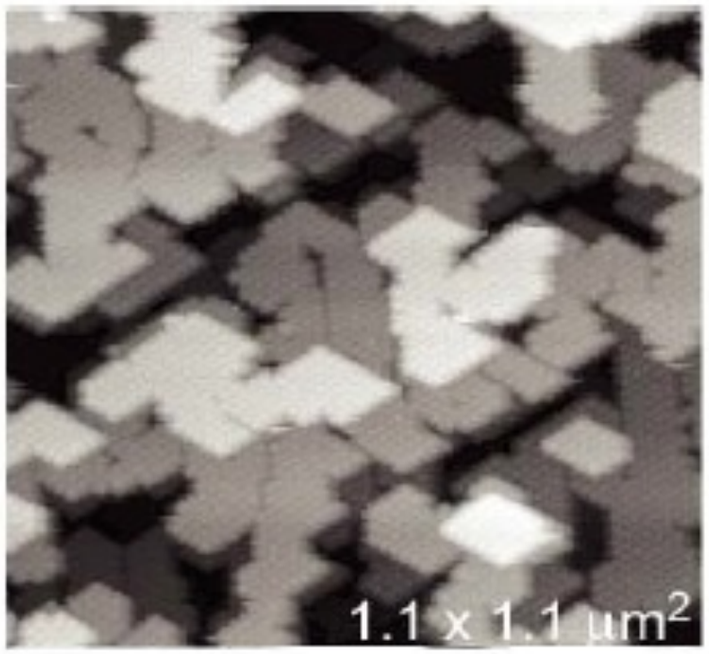
→ Mininum supersaturation is required

Below a critical driving force no 2D nuclei will form…

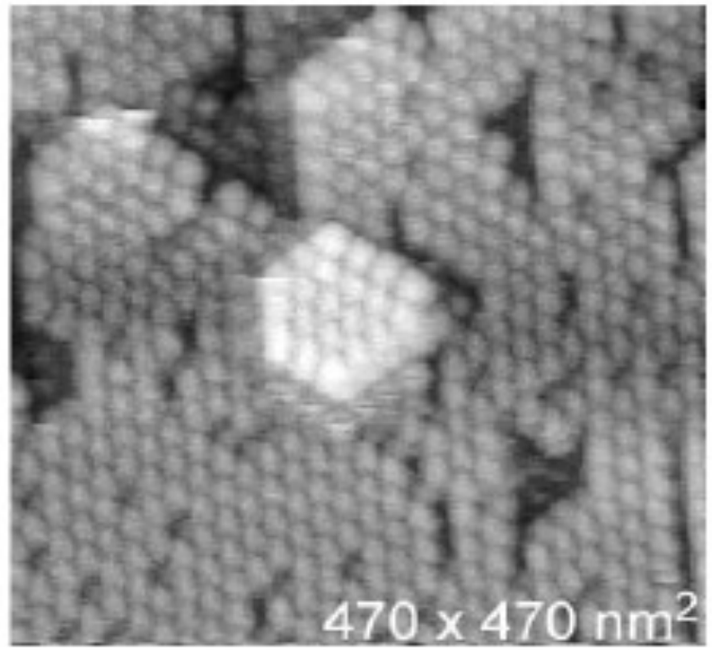




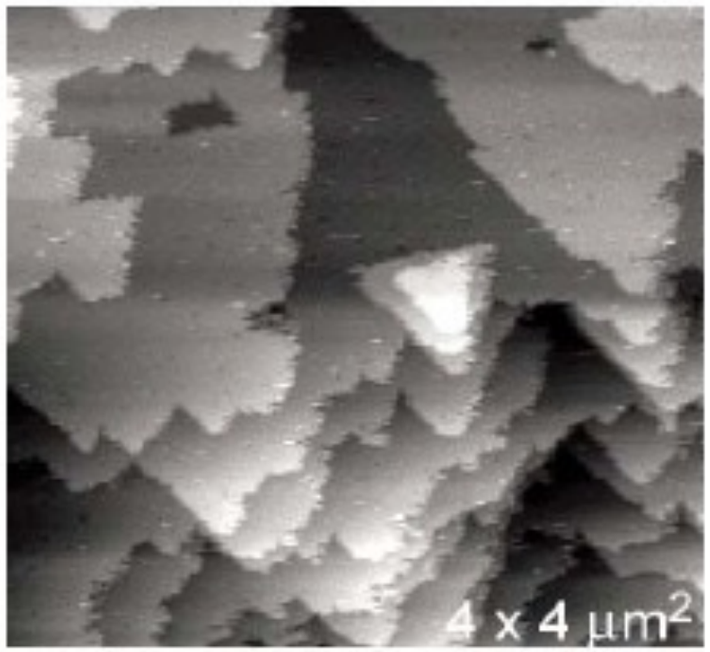
a



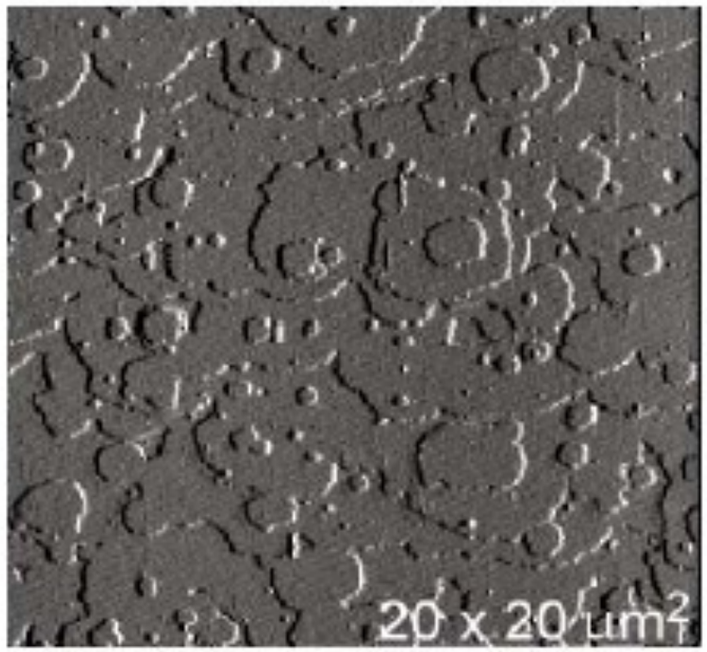
b



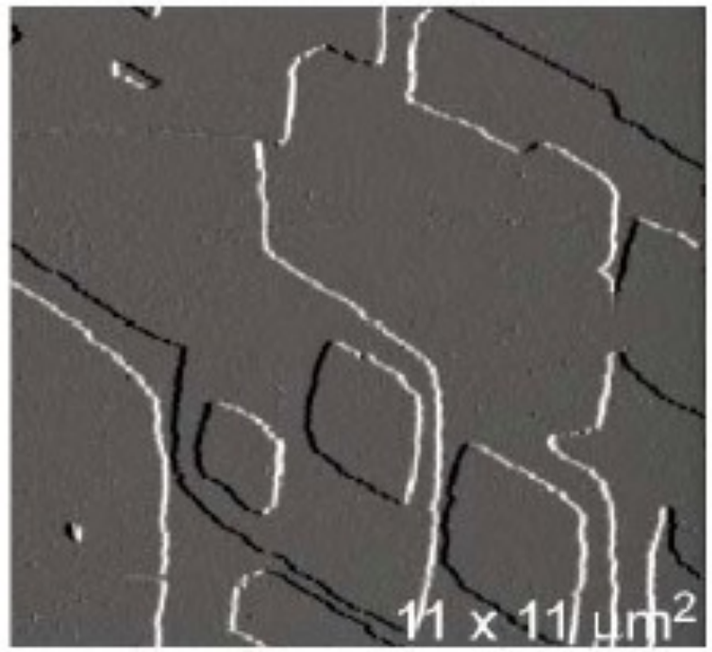
c



d



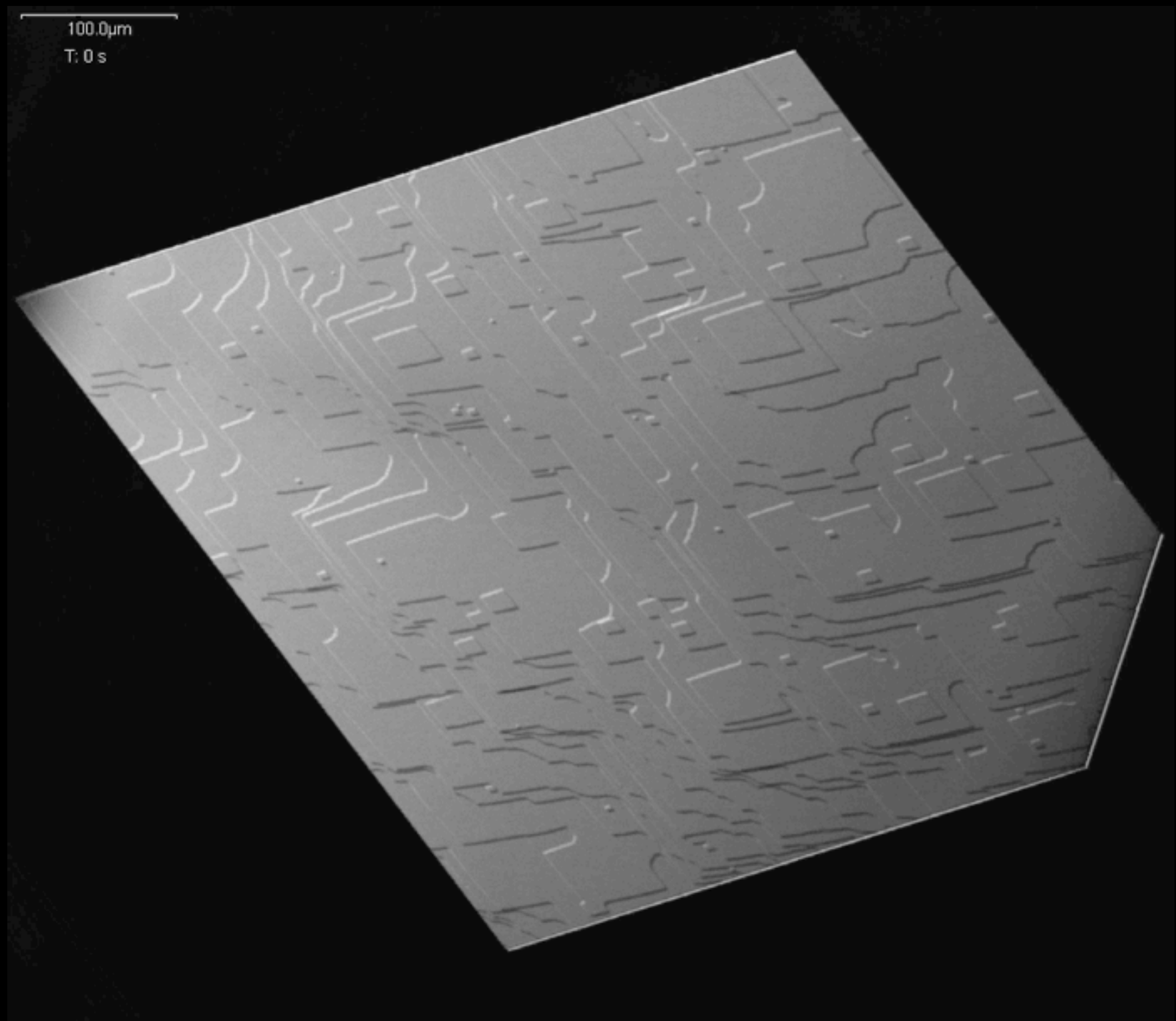
e



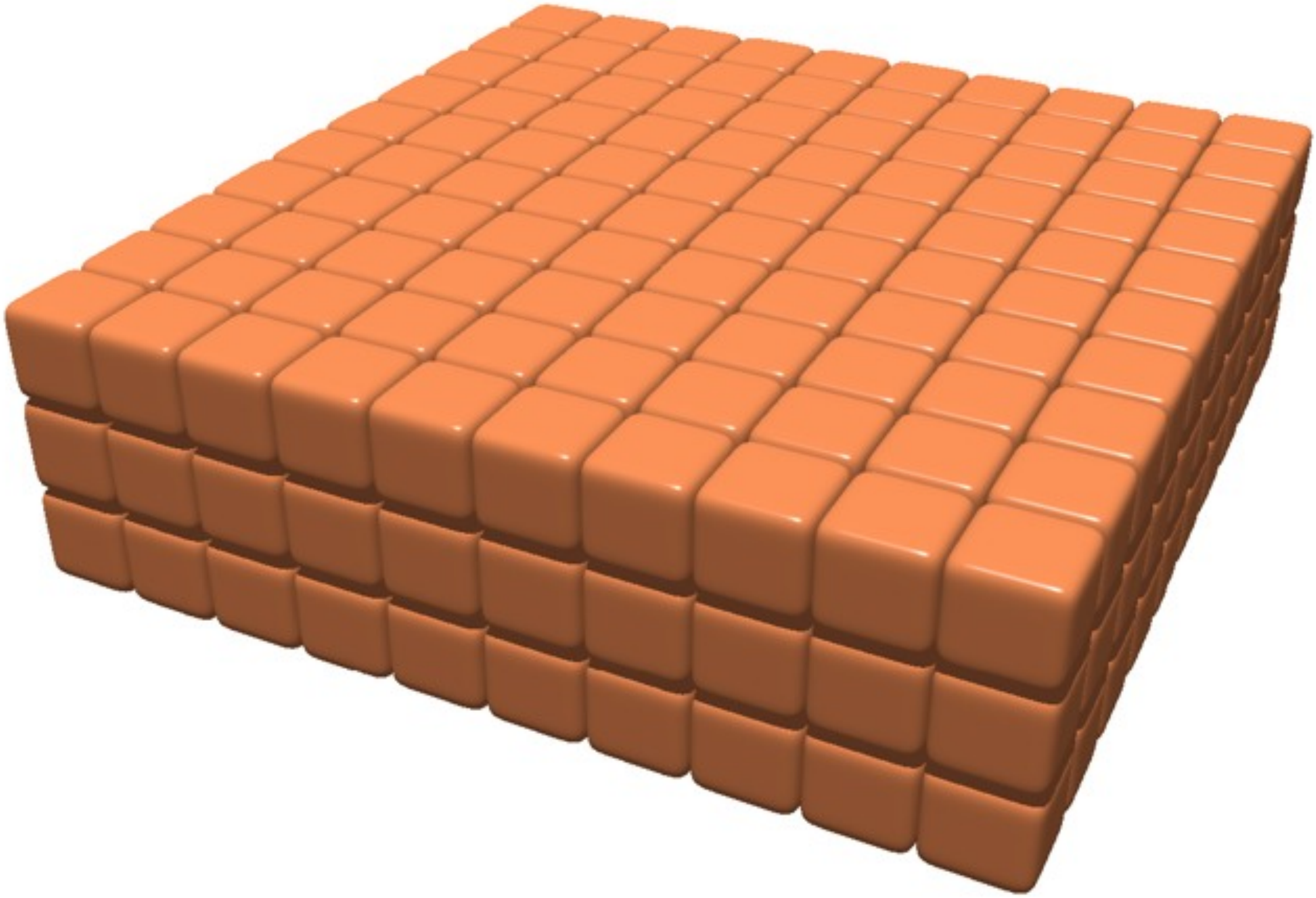
f

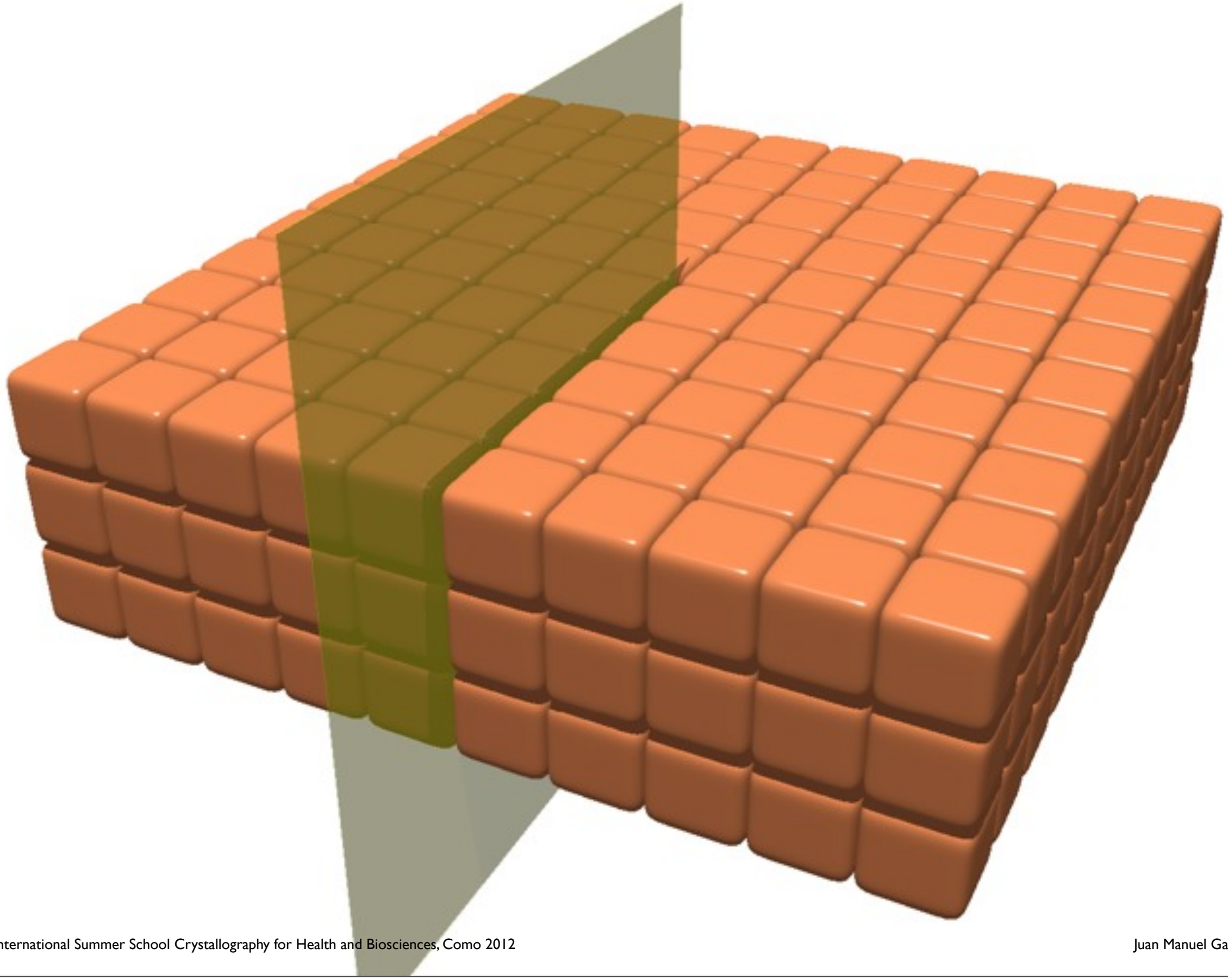
A. McPherson, Y. G. Kuznetsov, A. Malkin & M.Plomp, Macromolecular Crystal Growth As Revealed By Atomic Force Microscopy

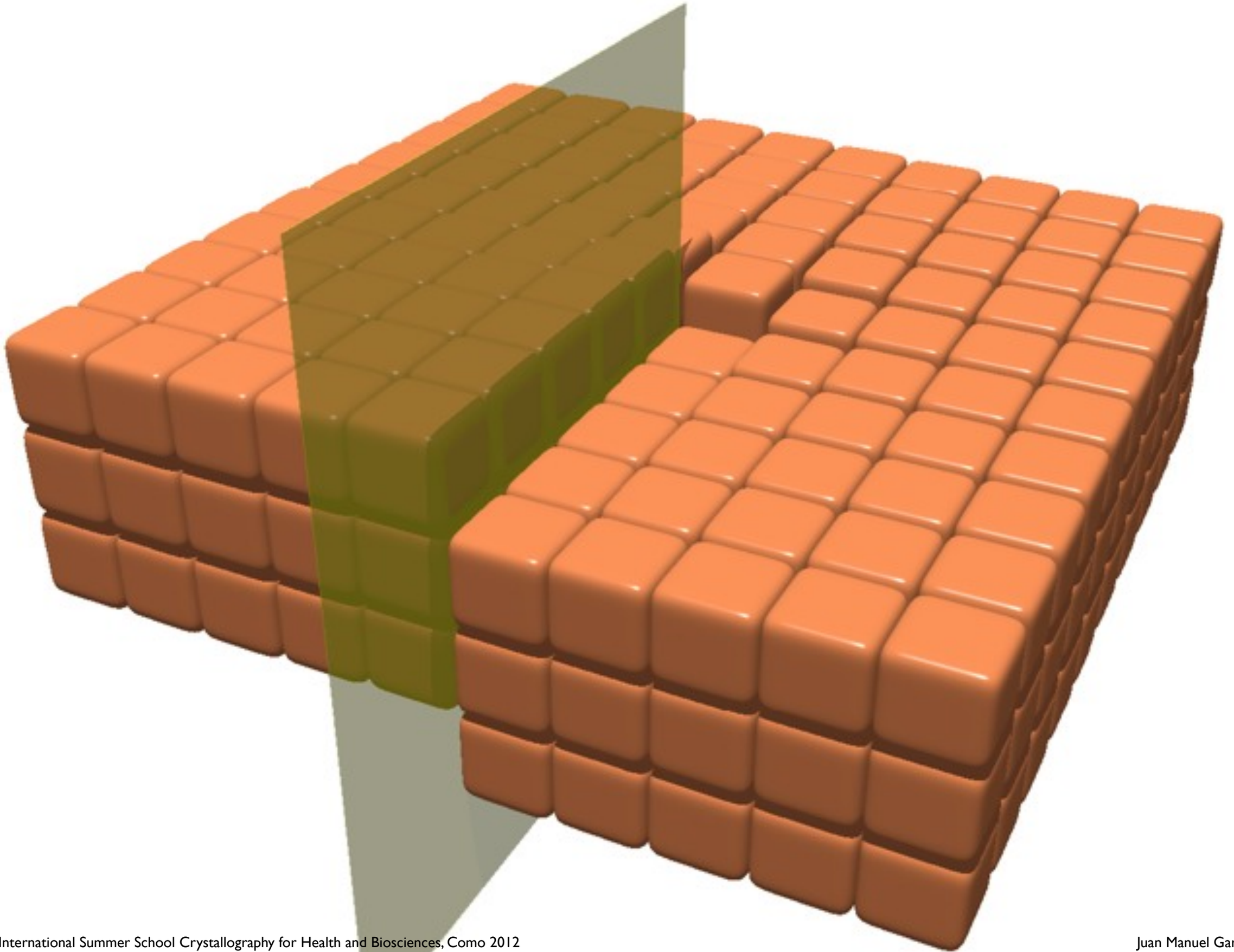
Two dimensional nucleation

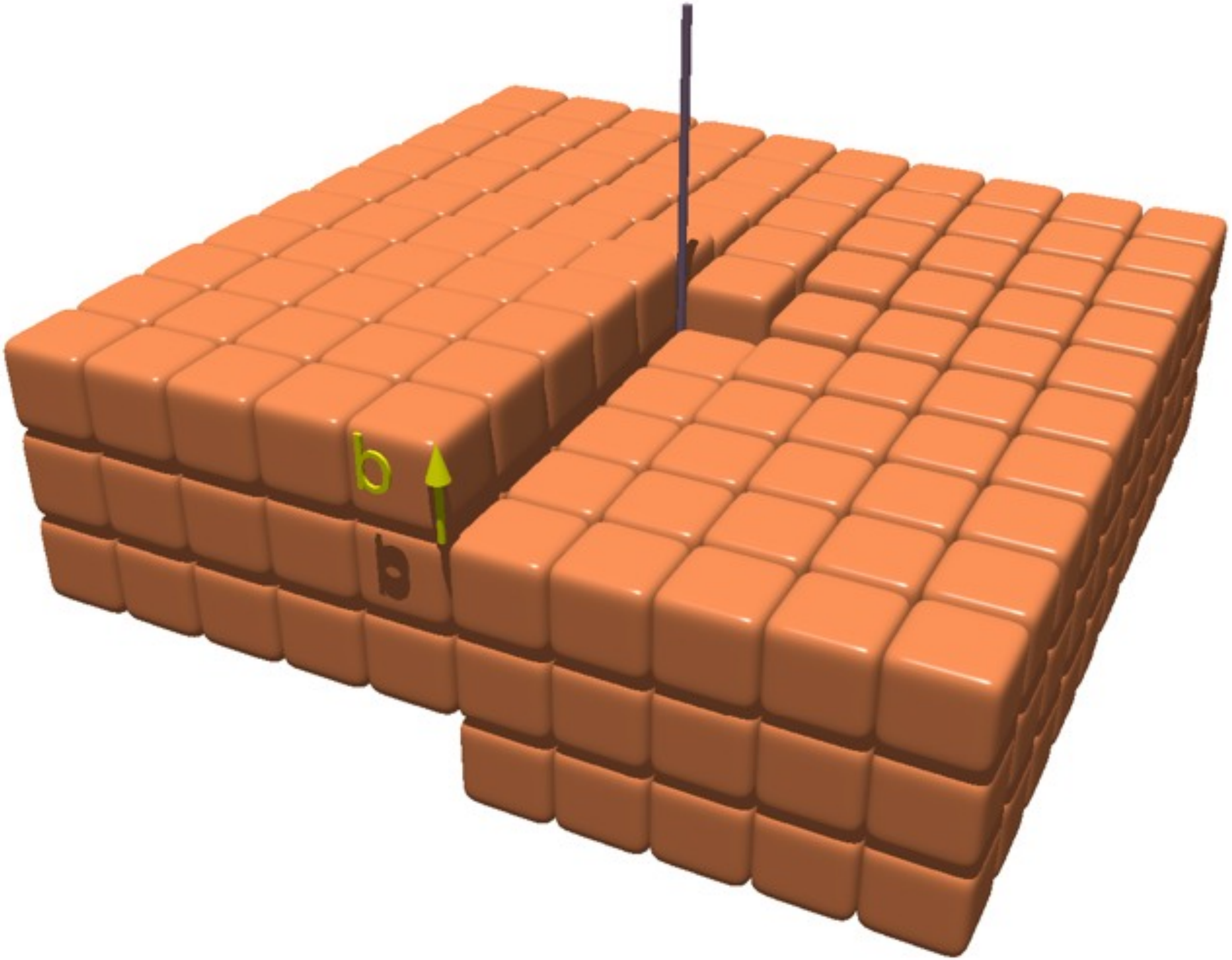


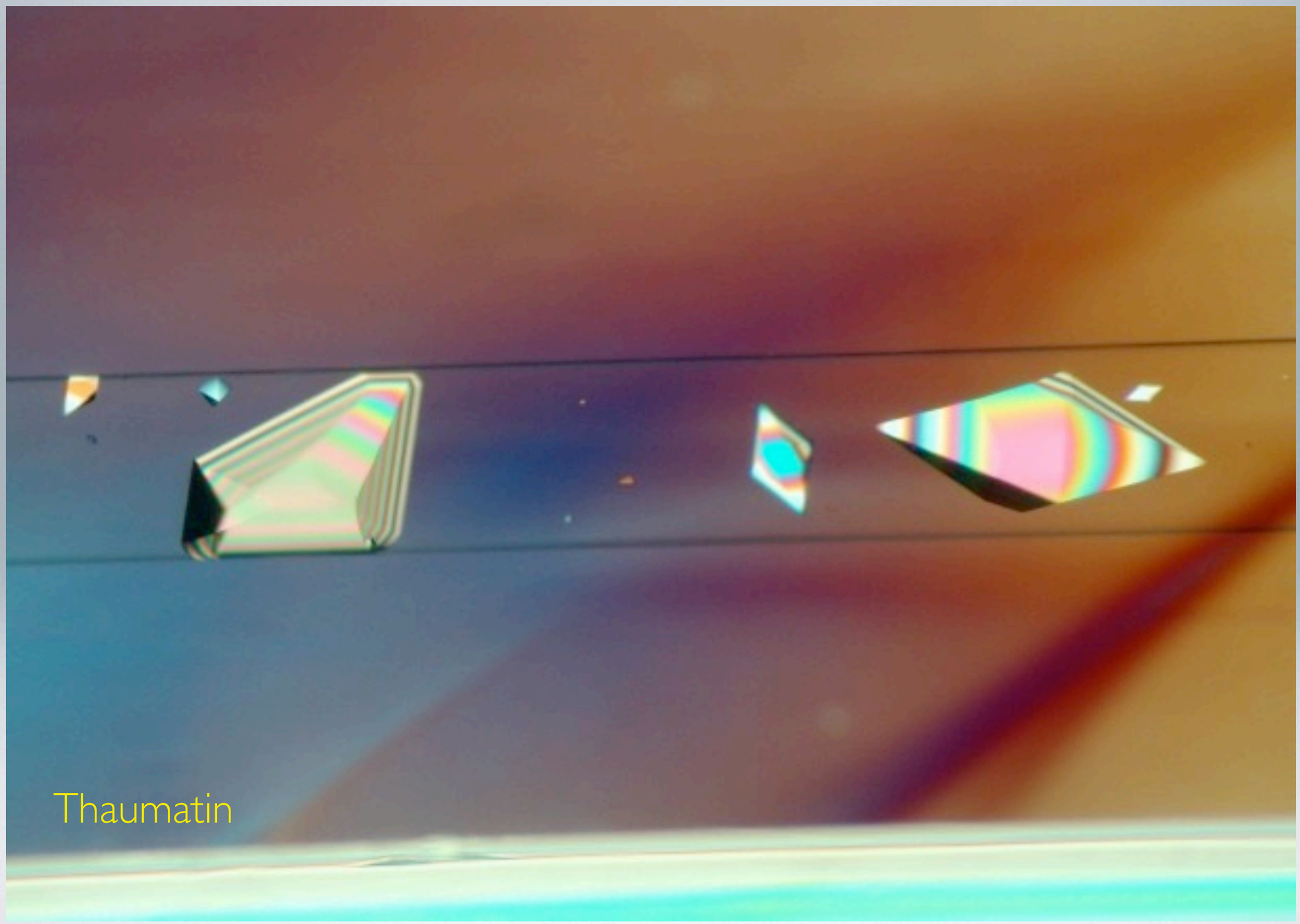
Crystal Growth Mechanisms
Screw dislocation

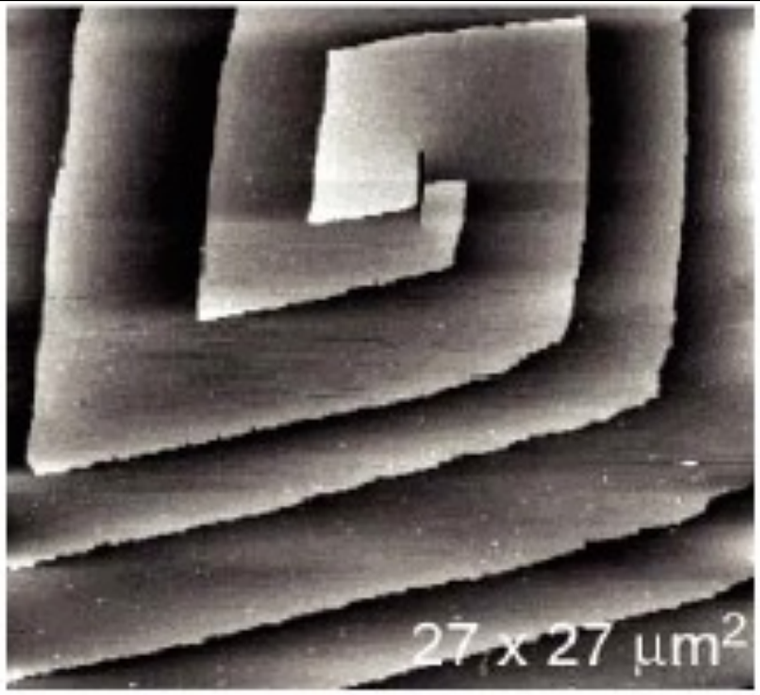




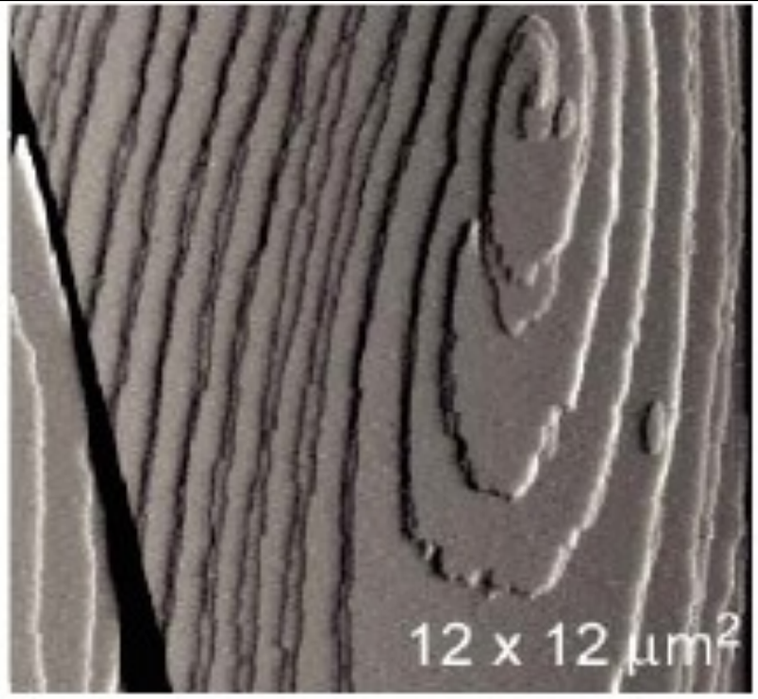



b
b

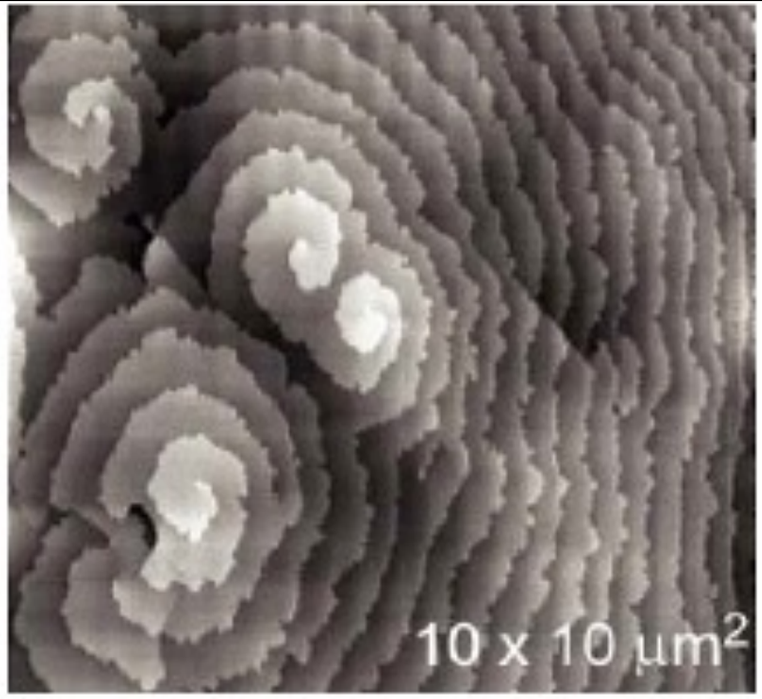

Thaumatin



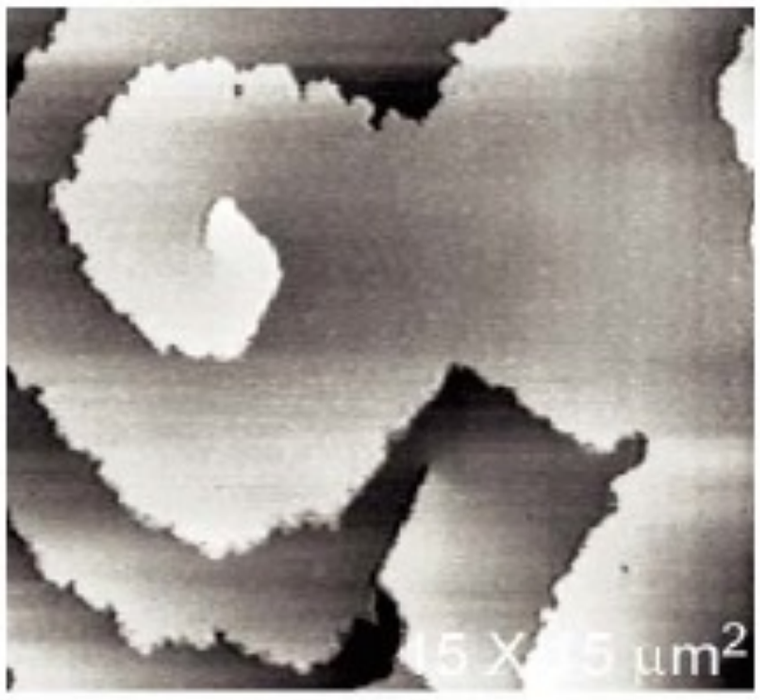
a



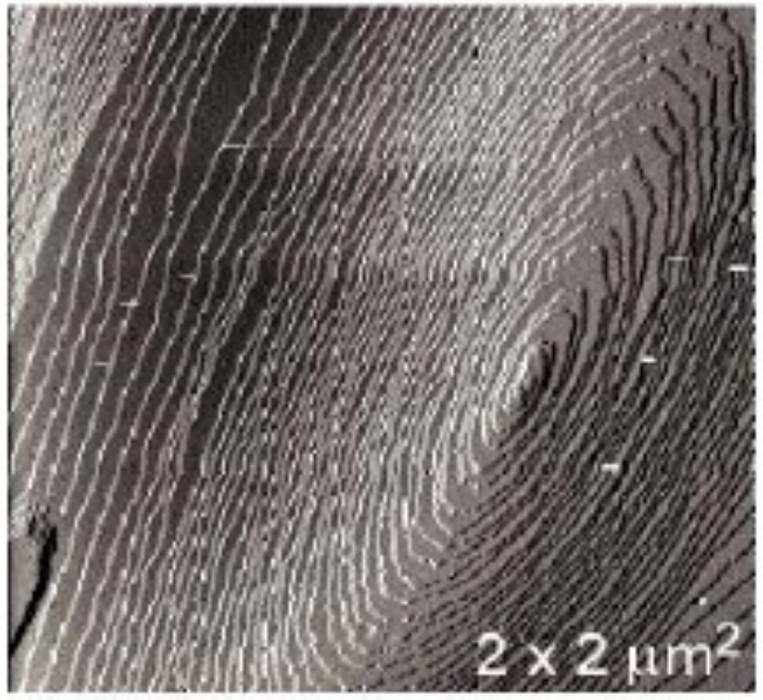
b



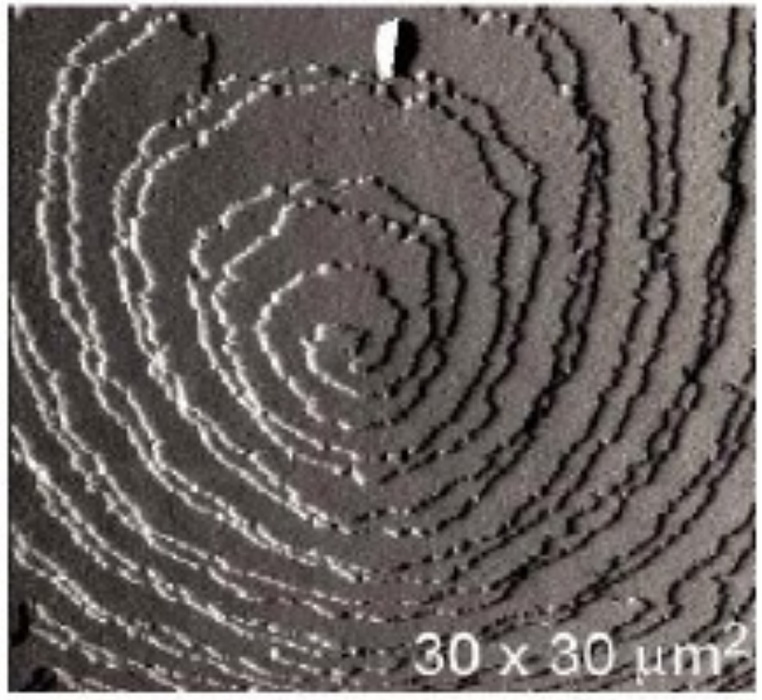
c



d



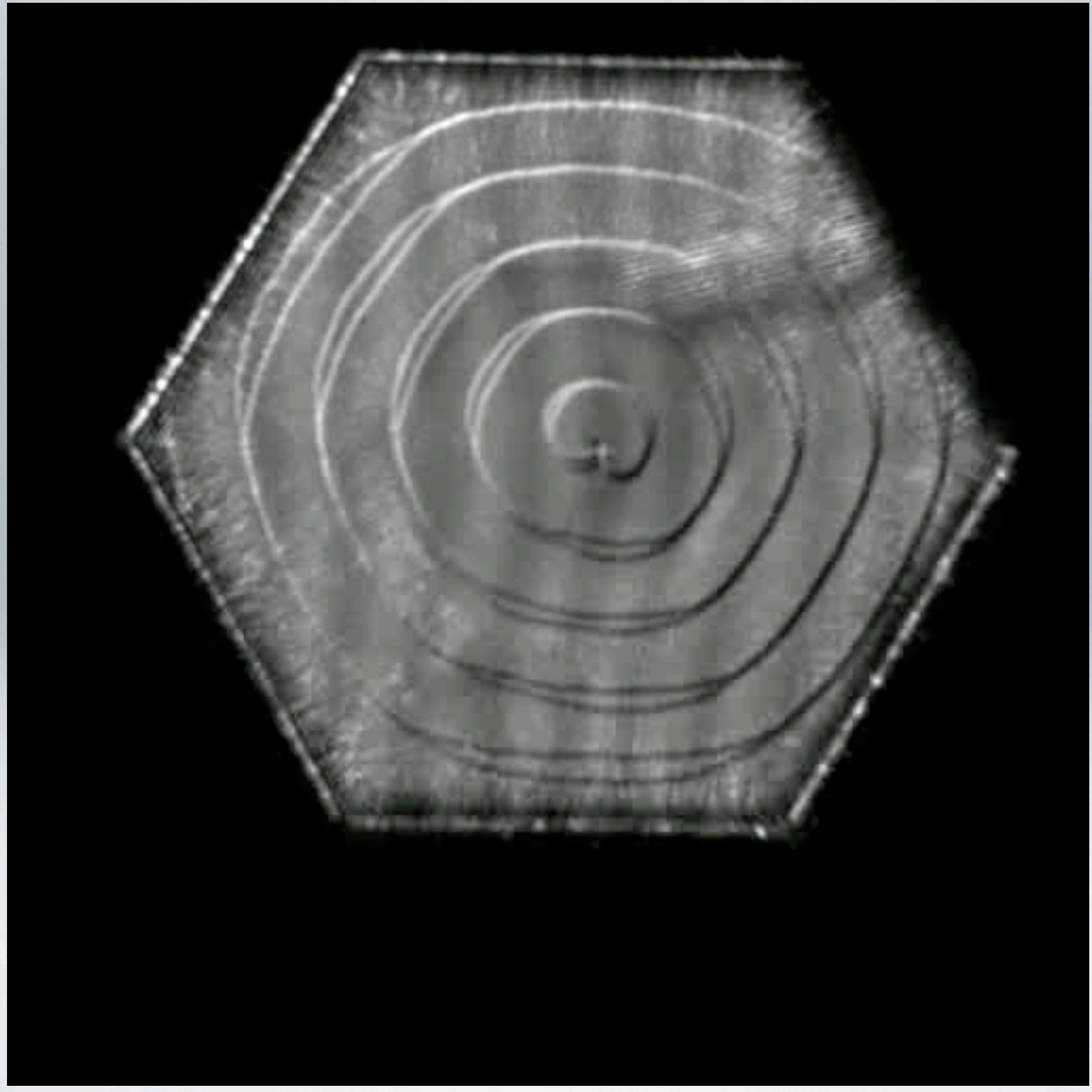
e



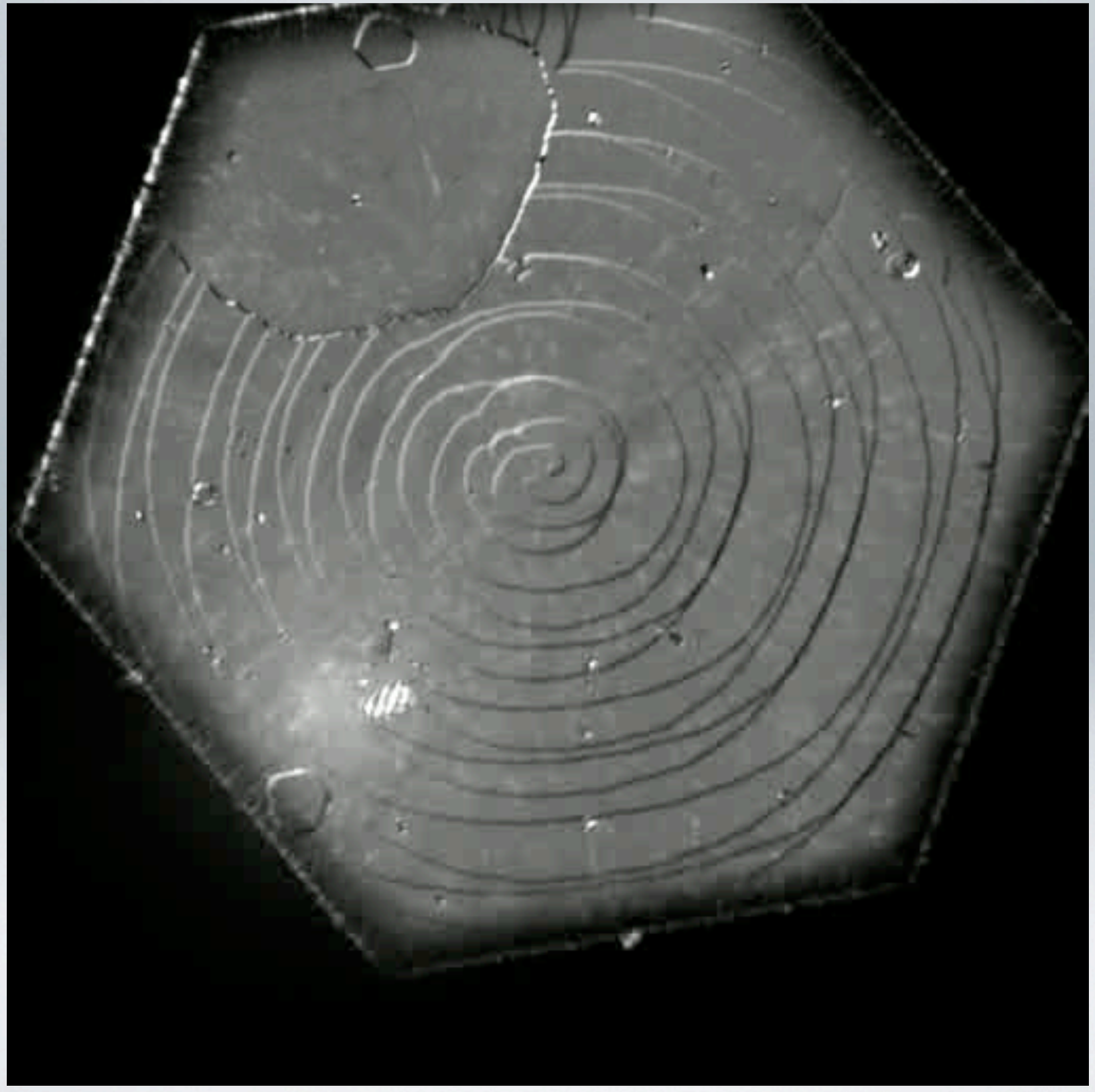
f

A. McPherson, Y. G. Kuznetsov, A. Malkin & M.Plomp, Macromolecular Crystal Growth As Revealed By Atomic Force Microscopy

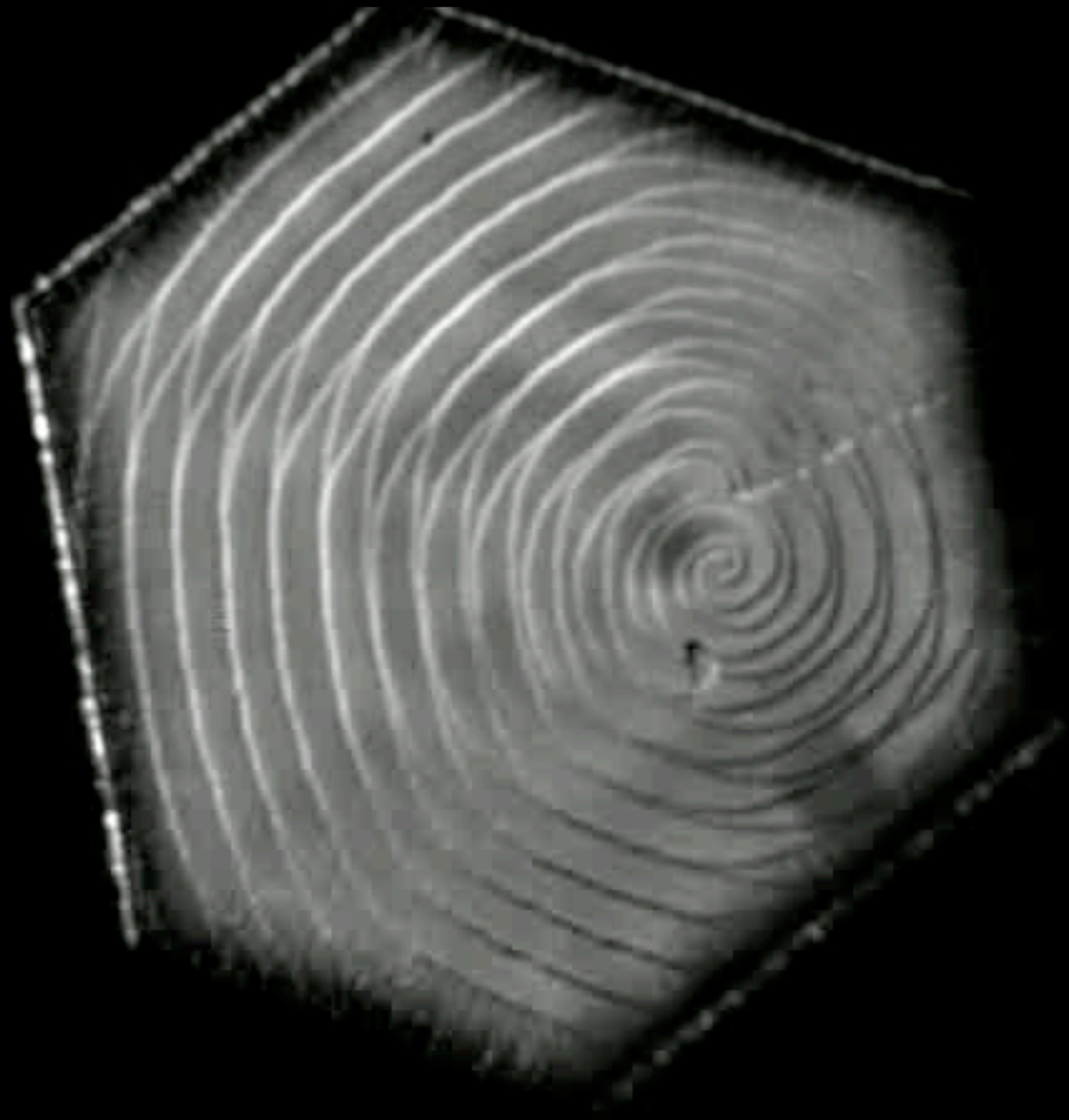
Screw dislocation growth

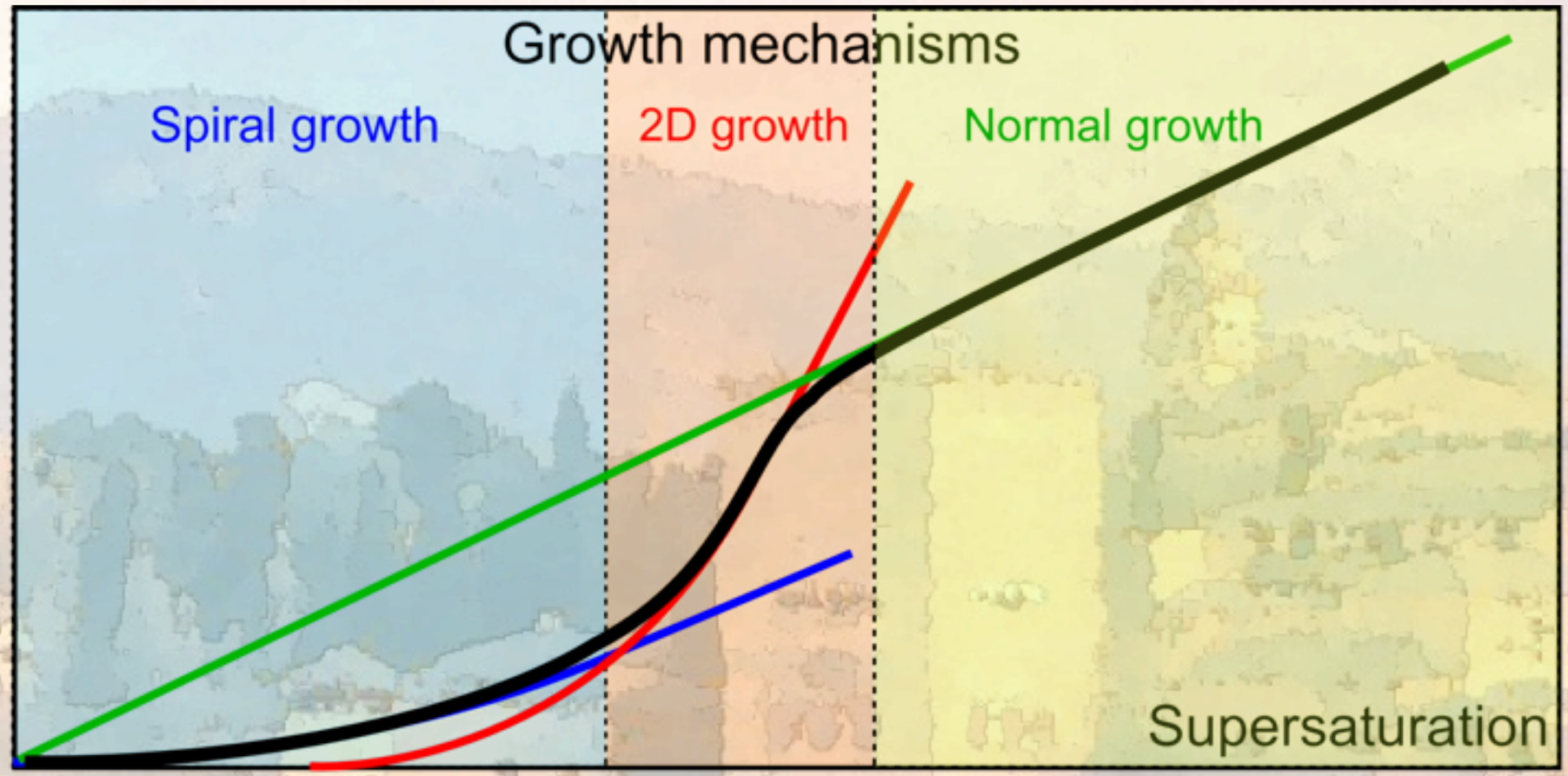


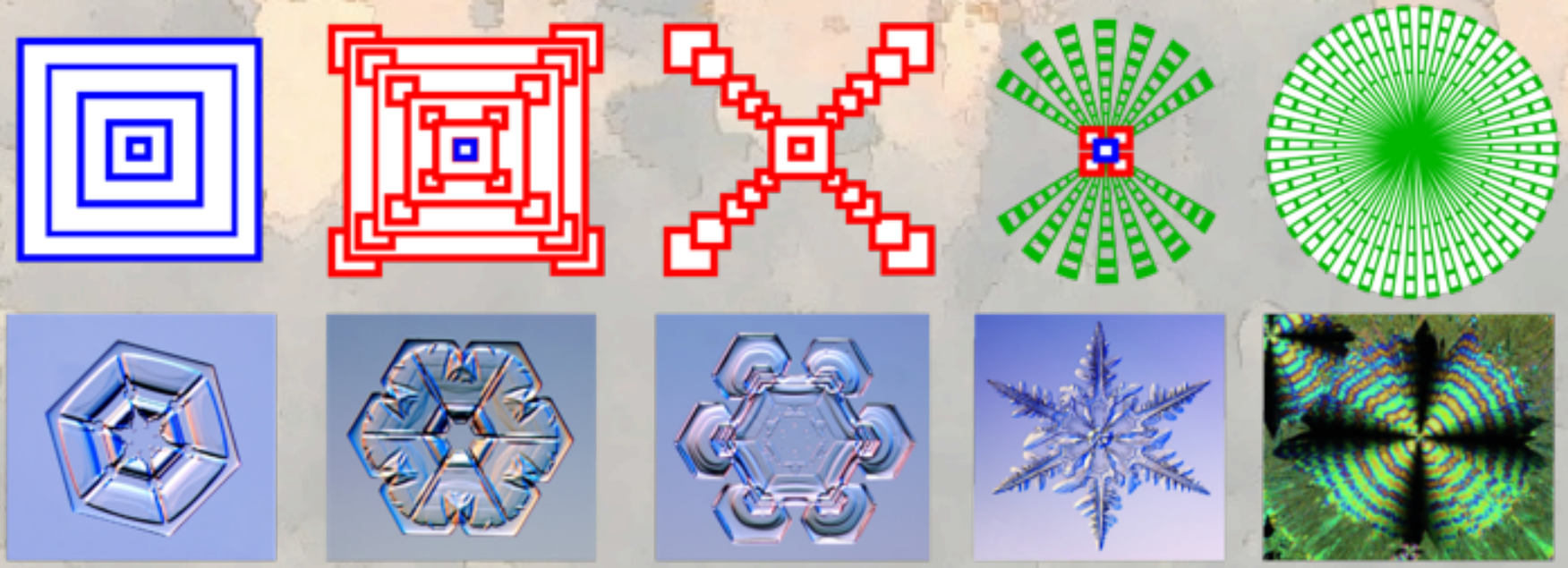
Screw dislocation growth



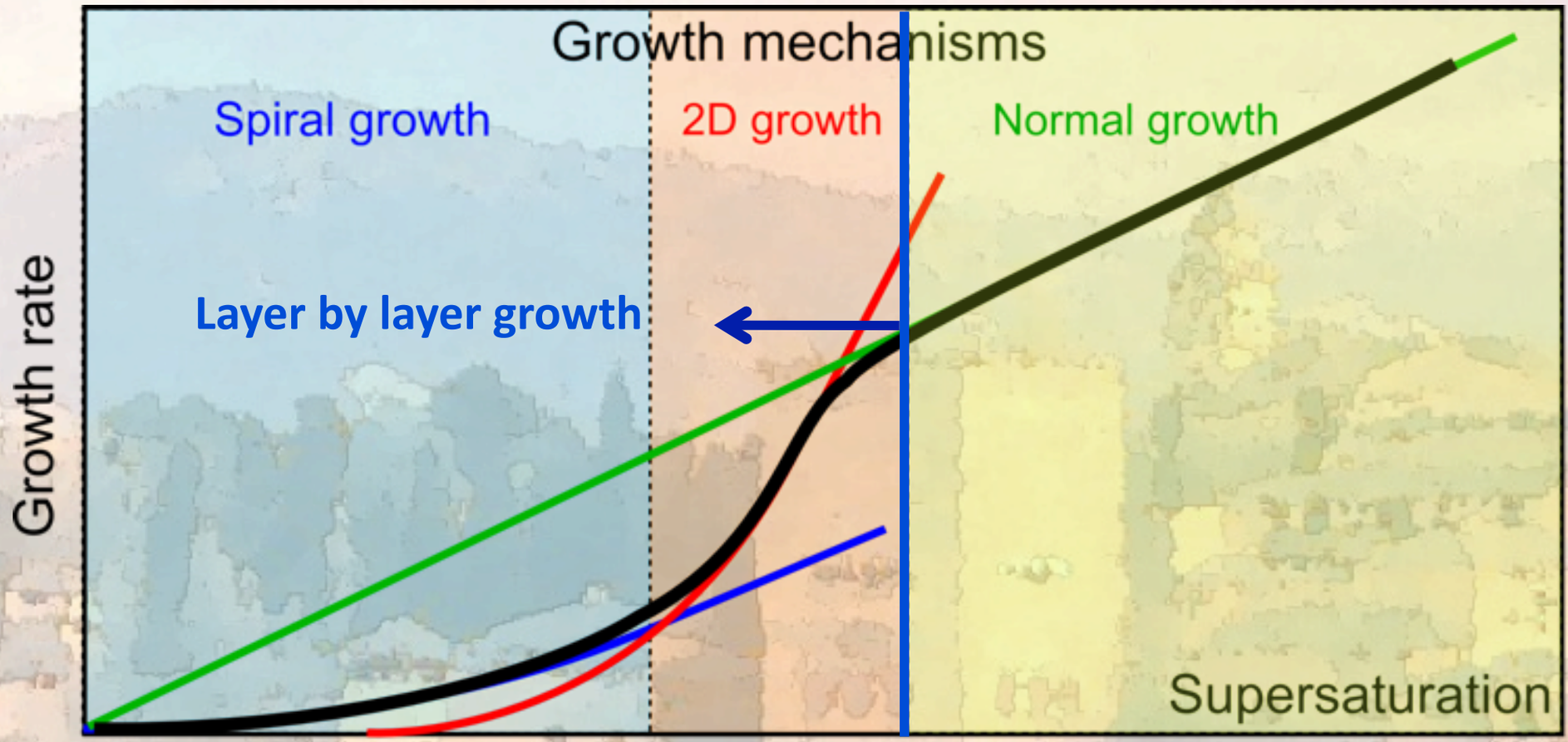
Screw dislocation growth

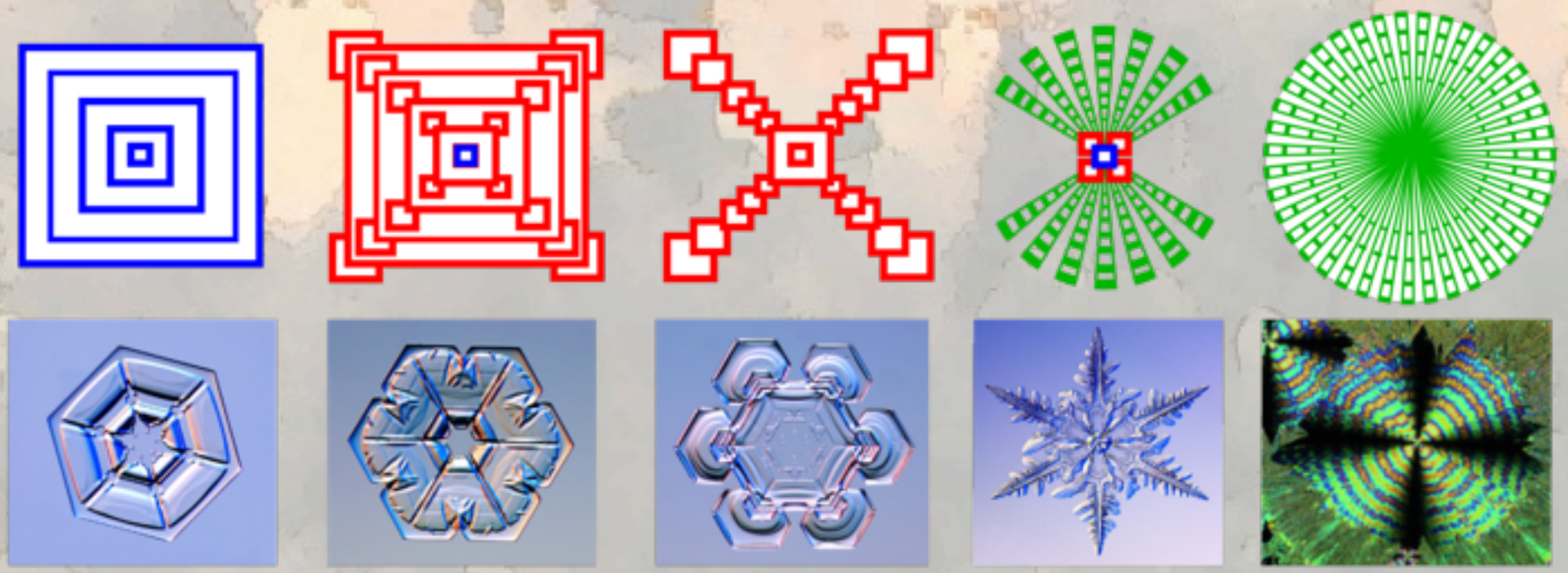




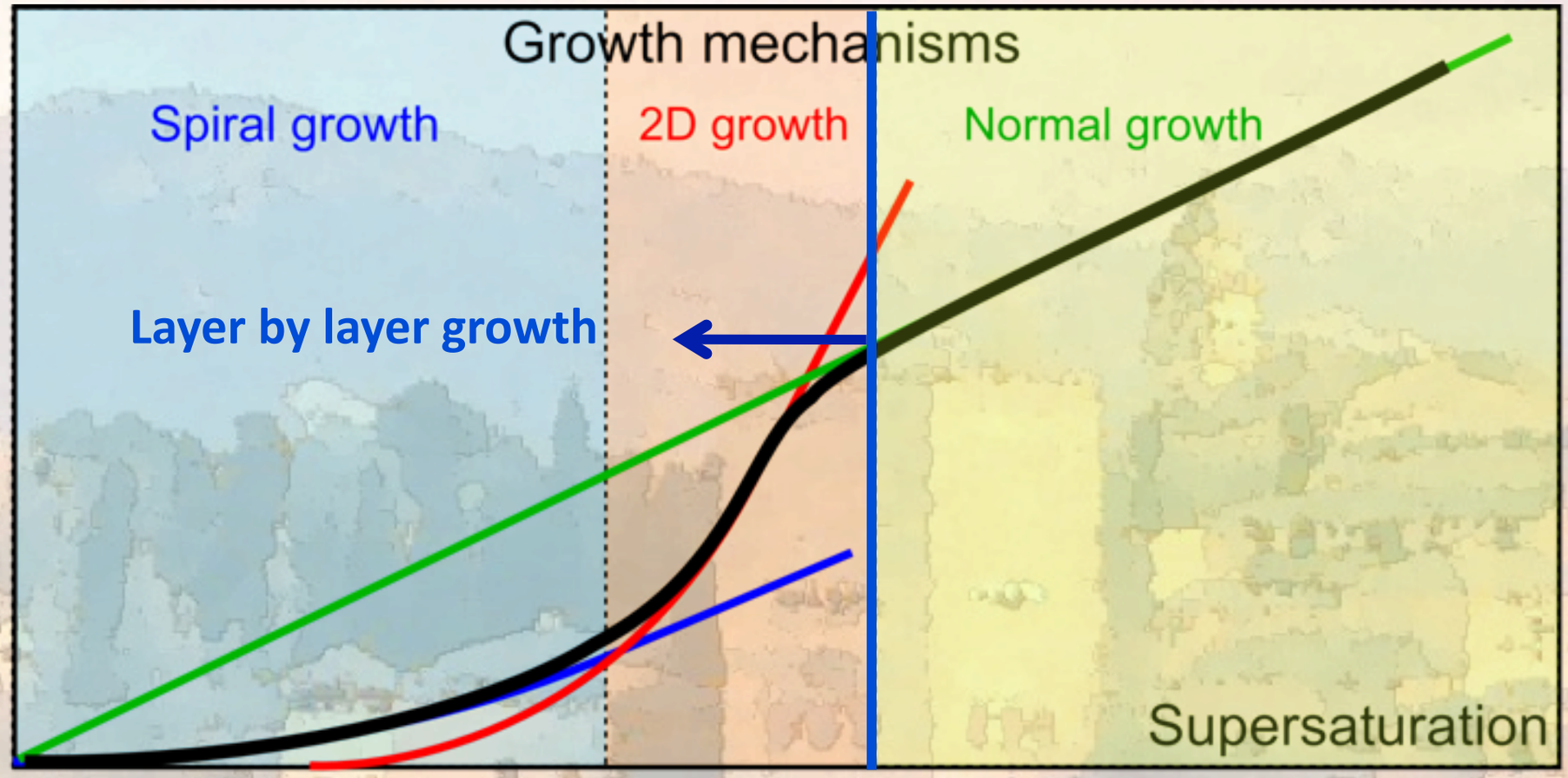


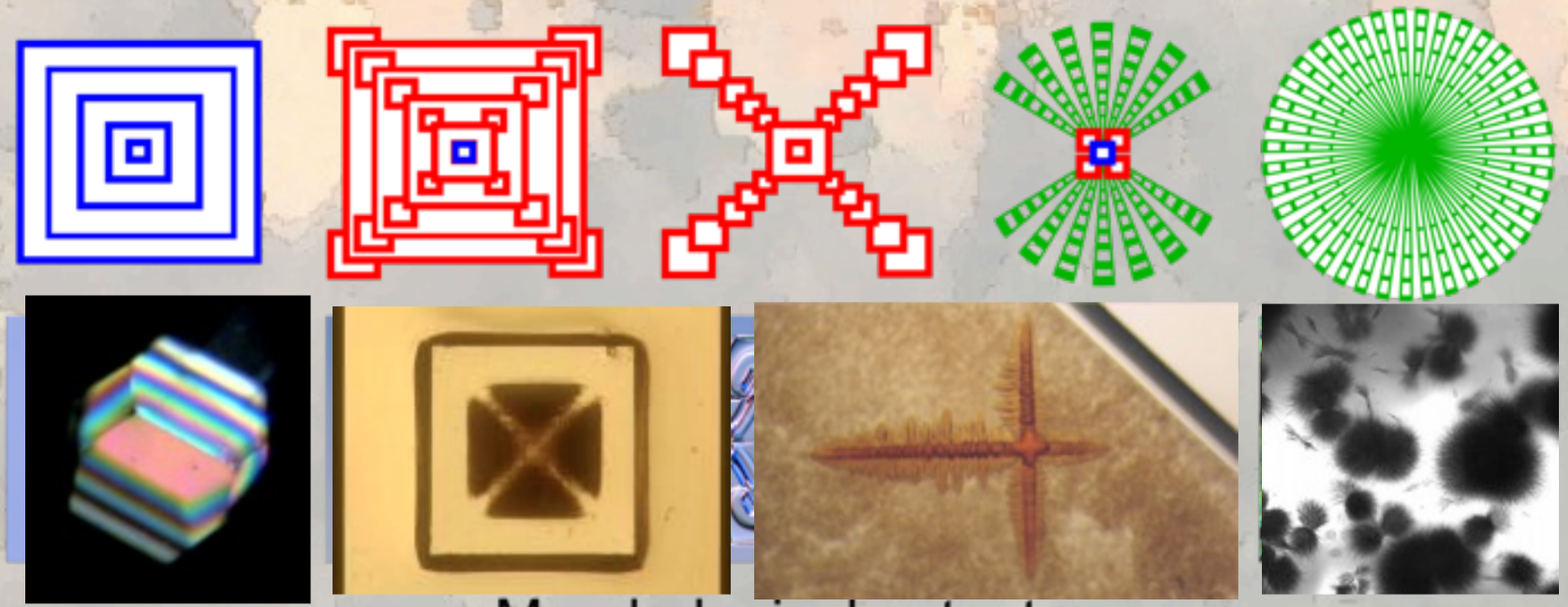
Morphological output





Morphological output





Morphological output