

## Homework #9 Solutions

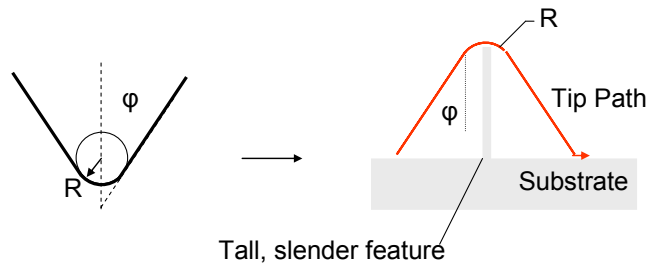
### Problem 33

a)

The resolution of AFM becomes difficult to define because of the various factors that may affect the output. One such factor is the height variation of the features as shown in Box 1. When the height variation is very small, AFM can resolve features that are separated by a small distance, often much less than the size of the tip. Otherwise, AFM cannot resolve them.

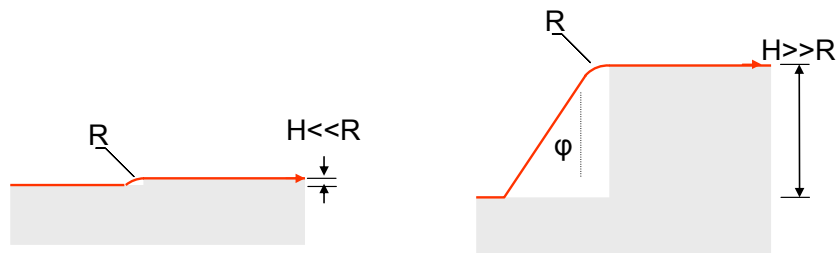
b)

The image is effectively that of the probe tip inverted.



c)

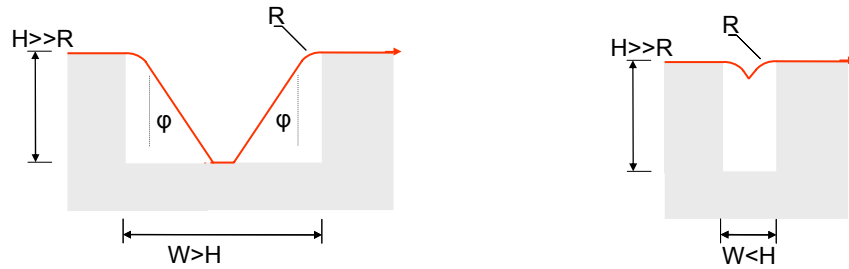
Edge height can greatly affect imaging resolution:



d)

Channels with width smaller than the tip radius result in poor imaging





e)

The tip is susceptible to breaking when the feature is a large step and if the angle of approach  $\phi$  is low. This can be improved by using the probe in tapping mode.

### Problem 34

SIAM utilizes the polarization variation of the reflected light due to dipole-dipole coupling between the sample surface and the tip to detect the topology of the sample. Because such interaction happens over very small range, only proportional to the size of the tip, this scheme can achieve resolution that is much higher than what was discussed in Lecture 2.

### Problem 35

Nanotubes offer many advantages over conventional AFM tips. Their small size and high aspect ratio allow for profiling deep trenches and small features. They are flexible enough to survive crashes yet rigid enough to provide accurate measurement. Finally, nanotubes can be electrically conductive which allows them to be used in tunneling applications.