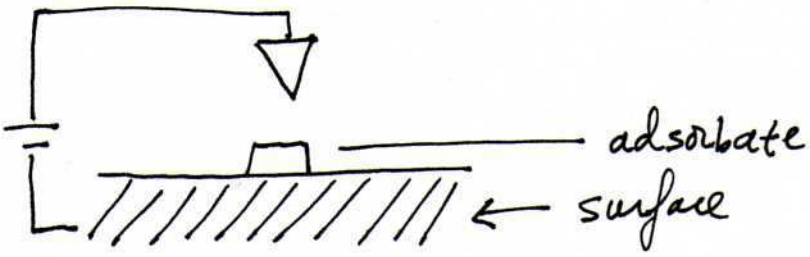
Scanning tunneling microscopy (STM) - invented ~20 years ago



Apply voltage - measure current

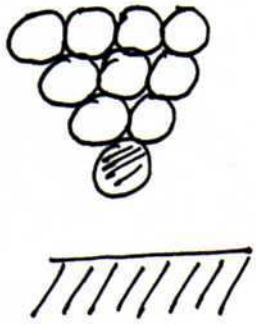
often run so that as the tip is scanned over the surface, the height is varied so as to keep the current constant.

the tip does not actually touch the surface

e^- tunnel between tip and surface

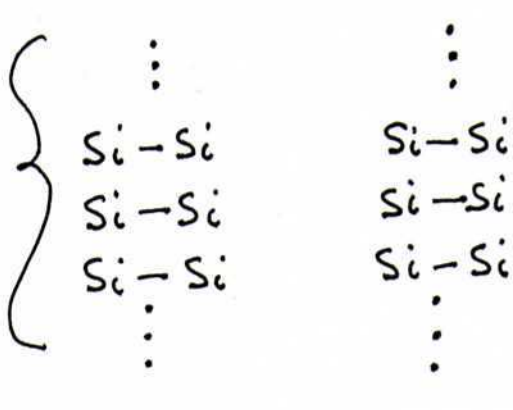
Atomic level resolution

tunneling dominated by single atom at the end of the tip

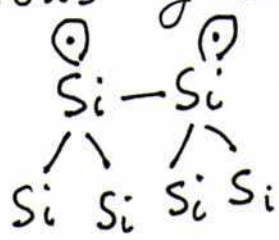


Can study defects and adsorbed molecules on surfaces.

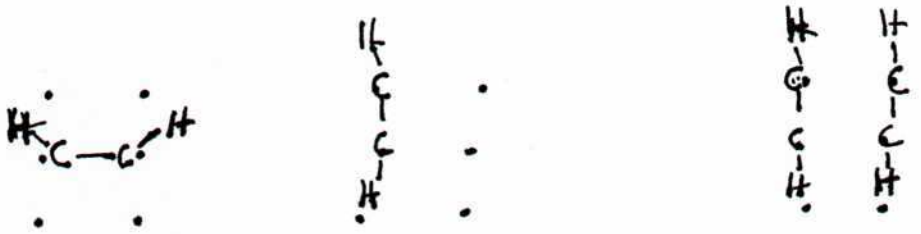
top view



Si(100) surface - rows of silicon dimers

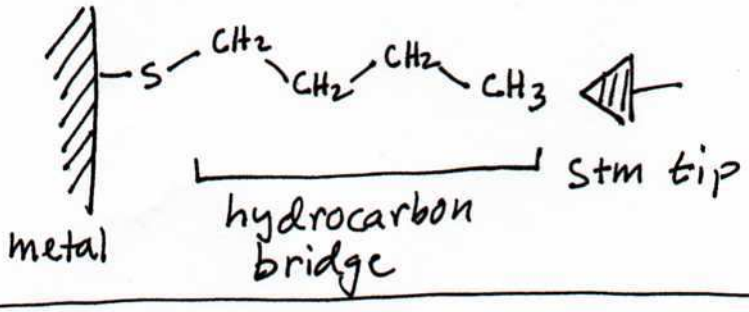


STM measurements (John Yates - Pitt) show 3 binding sites of acetylene on the surface



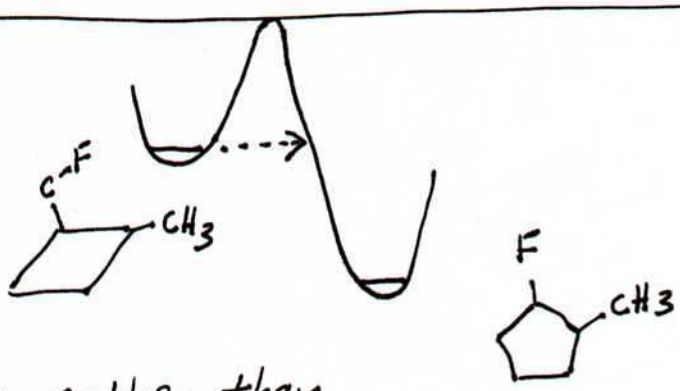
on-top dimer bridging two dimers two acetylene molecules on two dimers

Can also study tunneling through molecules



tunneling current falls off exponentially with distance

Reaction is 10^{152} times faster than expected at $T = 10K$.



It proceeds via tunneling rather than going over the barrier.

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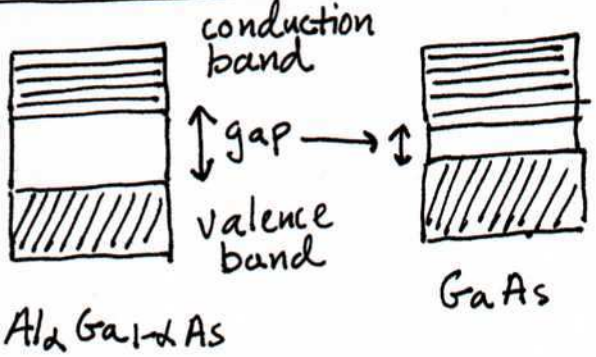
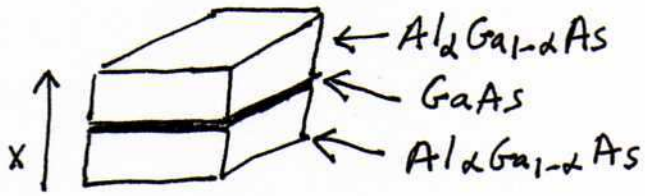
quantum wells



GaAs has a smaller band gap.

Make a layered device



electron is free in y, z directions and confined in the x direction.

Such systems can act as lasers.

quantum dots

← CdSe dots

emits green red ← fluorescence

used as tags to study processes in cells.