Making an Atomic Force Macroscope

The Atomic Force Macroscope is intended to mimic the operation of the real research instrument, the Atomic Force Microscope. If students can come to "see with their" minds what the instrument measures, then they can use real AFM data to accept that the world – at the atomic scale -- is granular. The real AFM makes use of a nearly horizontal lever and reads the displacement by the deflection of a laser beam. The Atomic Force Macroscope uses a vertical probe, so that students can more easily associate position visible to them with the position of the end of the probe that touches the atoms, which is not visible to them.

Materials/Equipment Required

Xerox paper box
flannel material to cover the bottom of the box
(looser flannel seems to hold velcro better)
foam pipe insulation (4 ft) -- 1-3/8" OD seems to work well.
"industrial strength" Velcro, 1" wide (hook form)
Spray glue
30 gallon black garbage bag
masking tape

Instructions

1. For a view of the box portion of the AFM, see figure 1. Glue the flannel securely to the inside of the bottom (but not the sides) of the box. Spray glue works well because it provides uniform coverage. Liquid glue or glue applicators tend to provide streaky coverage, and when force is applied to the flannel, it pulls away from the cardboard bottom of the box.

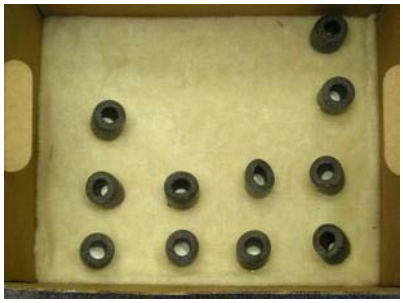

Figure 1: Top view of open AFM

2. Cut the length of the foam pipe insulation in half. One piece will become the probe. Cut the other half into segments whose length is approximately equal to the diameter of the foam pipe insulation. These will be the "atoms".

Figure 2: AFM atom

3. Cut 1" square pieces of the "industrial strength" Velcro, and glue them to the "atoms" with Velcro on only one end of the "atom".

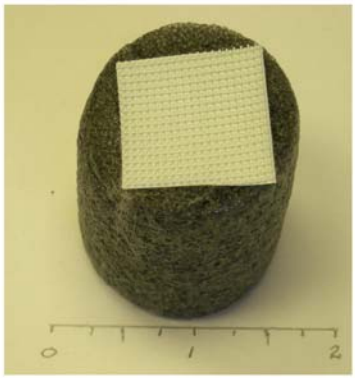

Figure 3: Velcro on bottom of AFM atom

4. The students should not see into the AFM, so tape the garbage bag over the AFM box, and cut a hole (just big enough for the probe to go through) in the upper end of the garbage bag.

Figure 4: AFM with probe

Figure 5: AFM with probe and cover

5. When the "atoms" are placed on the "surface" (flannel covered bottom of box), they should be placed at least one diameter apart, so that the probe can detect them as separate atoms.

6. To rearrange the atoms, remove part of the masking tape, rearrange/remove/add atoms and retape.

Suppliers

(I have no financial interest in any of these suppliers.)

Xerox paper box – anybody who has a Xerox machine
flannel cloth – fabric sales (I bought mine at Walmart.)
foam pipe insulation – hardware store (I bought mine at Home Deport.)
spray glue – fabric/crafts sales (I bought mine at Walmart.)
garbage bags/masking tape – grocery store/hardware store

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