

Module Title: Photolithography

Module Section Title: Spin coater assembly plans

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The Photolithography demonstration requires a method to apply a thin liquid film of light-sensitive material to a substrate. This may be done by spray coating or dip coating, but in the industrial setting spin coating is most often used. A spin coater is a small, enclosed turntable that spins at a pre-set rate; commercial spin coaters may operate from 800 to 5000 rpm or higher and hold a wafer on its platter with a vacuum. For this demonstration, a simple spin coater that spins at around 3000 rpm can be fashioned from a case cooling fan, a plastic food container, and some hardware. To build this spinner, you'll need access to tools that can be found in a home or school workshop.

Materials

Item	Source and ordering info	Notes
120VAC cooling fan (1)	Radio Shack, Cat # 273-242	Fan: 
Lamp cord with plug, at least four feet in length (1)	Hardware store	Grounded plug not required
In-line switch (1)	Hardware store	
Drawer pull with flat front, about 1" dia (1)	Hardware store	Example: 
1/4" long flat head machine screw (1)	Hardware store	Should be sized to thread into drawer pull
Epoxy (as needed)	Hardware store	
Five cup plastic food storage container, with lid (1)	Hardware or discount store	Example: Rubbermaid
8-32 x 2" machine screws (4), nuts (4), and spacers (4)	Hardware store	
1/8" thick plastic sheet,	Hardware store	May be acrylic (Plexiglas), polycarbonate,

square, about 4 ½" on a side (1)		or other hard plastic
#4-40 x ¼" nylon screws (3)	Hardware store	
#4-40 x ~1" steel screw (1)	Hardware store	This will be used to cut threads in the plastic; length is not critical
1 ½" PVC pipe, short (1)	Hardware store	Will only use a small end from this pipe, so use a small scrap piece if possible

Assembly procedure

Fan enclosure

1. Remove the lid from the food storage container and place the container open-side down on a surface.
2. Using the fan body as a template, mark the position of the four mounting holes on the fan housing.
3. Draw diagonal lines between these corner hole positions to locate the center of the fan. Mark this location also.
4. Drill a 3/16" dia hole through the plastic container at each of the four corner marks.
5. Drill or cut a ¾" dia hole at the center mark.
6. Check to ensure that a) the mounting holes on the fan body line up with the holes you've drilled and b) the center of the fan is aligned with the larger hole in the center. Re-drill holes if necessary.
7. Cut a piece of 1 ½" PVC pipe, 3/16" to ¼" long. Lightly sand the ends of this ring to make it smooth and free of dust or burrs. Apply epoxy to the ring and glue it in position around the center hole you drilled in the plastic container. Allow to dry overnight.

Figure 1. Finished enclosure



Fan Assembly

1. Install the line switch on the lamp cord about 18 inches from the non-plug end.
2. Attach the lamp cord ends to the wires on the fan, using solder or solder-less connectors. Polarity of the wires does not matter in this case. Wrap the wire connections with plastic electrician's tape.
3. Place the fan on a flat surface, with the fan blades up. Locate the four mounting holes in the corners of the fan housing. Draw diagonal lines between opposite pairs of these holes; this will determine the center of fan rotation.
4. Apply a generous amount of epoxy adhesive to the flat front of the drawer pull. Position the pull so that it is exactly centered on the front face of the rotating fan. While the epoxy is still uncured, verify that the center of the drawer pull is aligned with the fan's rotation center by rotating the fan a few times. Adjust the position of the pull so that it is centered. Allow to dry overnight.



Figure 2a and b.

Finished fan motor assembly.

Spinner platform

1. Locate and mark the approximate center of the plastic sheet.
2. Using a compass centered on the mark you've just made, draw a circle with a radius of exactly 2 inches.
3. With the compass at the same center, draw another circle with a radius of $2\frac{1}{8}$ inches.
4. Place three marks at positions of 0, 120, and 240 degrees around the circumference of the circles you've drawn (see Figure 3). Place the marks in between the two circles.
5. Drill a hole sized to accept the #4 nylon screw at each of the three positions.
6. Thread a #4-40 steel screw into each of these holes, then remove. This will cut threads into the soft plastic so that it will be able to accept the nylon screws.
7. Screw a 4-40 nylon screw into each of the three holes. If the screws do not thread easily, try threading the steel screw in the hole again.
8. Drill a $\frac{3}{16}$ " hole through the sheet at the center. Countersink the hole to accept a flat head screw.

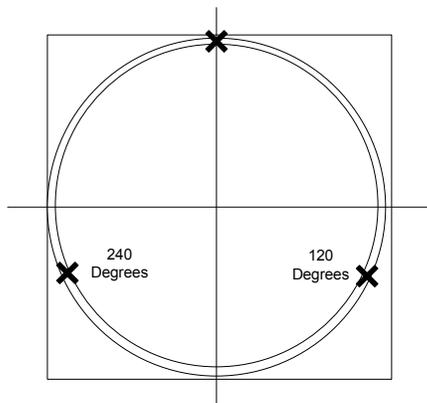


Figure 3. Diagram for placement of circumference marks.

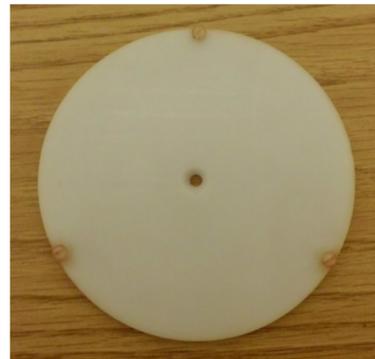


Figure 4. Finished spinner platform.

Final assembly

1. Place the enclosure open side down on a work surface.
2. Place a 8-32 x 2" machine screw in each of the corner holes of the enclosure.
3. Invert the enclosure while holding the screws in place. Place a spacer on each screw.
4. Insert a screw into one corner hole of the fan motor, then repeat for all the other screws. Work the motor and screws until all screws pass through the front and back holes of the fan housing.
5. Attach a nut to each screw.
6. Tighten the four nuts to hold the fan motor firmly in place.
7. Attach the spinner platform to the fan motor by threading the short flat head machine screw into the drawer pull attached to the fan.
8. Cut a small slot in the container lid to allow the cord to pass through when the lid is attached.



Figure 5. Finished spinner assembly.

Testing and troubleshooting.

1. Plug in the spinner and turn it on with the line switch. The platform should turn evenly without rubbing on any surface, and should steadily come up to full rotation speed over about 20-30 seconds.
2. Check to ensure that the platform is balanced, i.e., it has no wobbles or shaking at any speed. If the platform is not balanced, identify the heavy side and file or cut away small pieces of plastic from that side to improve spin balance. If desired, use a jig saw to cut the spinner platform to a circular shape, using the outer circle you drew during layout.

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