Supporting Information for “Electrospinning as fascinating platform for teaching applied polymer science with safe and sustainable experiments”

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Recipes

PVP (MW 1,300,000 g/mol) was purchased from sigma-aldrich. A solution of 5-10 wt% in ethanol electrospins in a wide range of humidities (i.e. 0-80%), a concentration of 7.5 wt% works very well with the student setup.
Details of the Electrospinning Setup

The high voltage source can be a dedicated instrument that can limit the short-circuit output current to 1 mA, as electrospinning typically only requires currents in the microampere range\(^1\). Another option is an “Electric Arc Module/Generator” that transforms 3-12 V DC up to about 10 kV (available at amazon, ebay, ... for about $10). The short-circuit currents are in the mA range and produce electric arcs over a distance of about 10 mm. To limit the current a high voltage resistance of...
5 or 10 MΩ (available at eBay for about $10 – DO NOT use an ordinary resistance) is inserted into the high voltage cable.

**Details of the Plasma Setup**

The Tesla Coil is available at online stores (Amazon, eBay, …) as “Mini Tesla Coil” for less than 10 $ that works fine with laptop power supply (15–20V) or as “Plasma Music Tesla Coil Module” for less than 50 $. The latter include a power supply and screwable discharge needles that are very useful.

A T-piece connector is placed over the needle and a septum with drilled hole is used to connect a glass tube. A shortened glass pipette works well with a wire placed inside. The wire can simply be wrapped around the discharge needle (no soldering needed) and can be placed to be approx. 5 mm shorter than the tube.

Note that the tee valve is optional, but can be used to control the gas flow (a needle valve is preferable) and use a second gas.
**Filtration**

Colored chalk can be finely ground in a mortar and be suspended in water.

![Image of filtration process](image)

*Figure 6* Filtration of chalk in water on a tea filter without (left) and with PS nanofibers (center) — without nanofibers the finer particles pass through the filter, whereas all particles are filtered out by the nanofibers mat (center/right)

**Safety**

Remember to exercise caution and follow general safety guidelines when working with high voltages and especially when modifying the setup.

The safe handling of injection needles must either be explained, for electrospinning it is recommended that the needles are clipped with the help of side cutters/pliers. This can be done in advance/as preparation.

For additional safety the high voltage resistance can be soldered to high-voltage cable of the generator. It may be instructive to show electric arc produced between the high voltage cable and ground if no or a lower resistance is present.

**Additional Experiments**

- Hot pressing the fiber mats to change/reduce to pore size of the non-woven mat
- Other polymers and molecular weights
  PS of low and high MW is useful to demonstrate the effect on spinnability and viscosity, i.e. the lower the MW, the higher the concentration has to be. Polymerization of styrene with high and low amounts of initiator can be done as preceding experiment.
  PVP of 1,300,000 g/mol serves as example of an ideal polymer for electrospinning.
- Parallel/Aligned Fibers
  Simply creating a gap (or placing an none-conducting glass slide) on the collector, results in parallel alignment
- Viscometry
  A rotational or Ostwald viscometer can be used to correlate solution viscosity with the electrospinning behavior

Additional References


