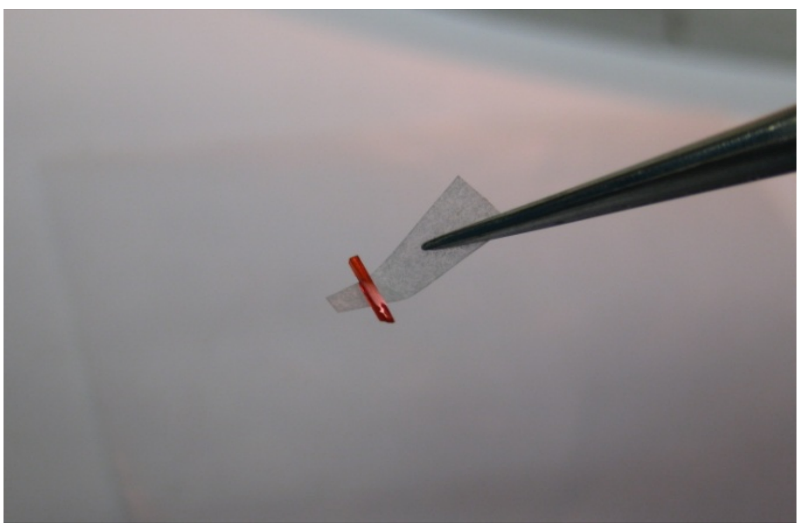
Technical notes: preparation of graphite contacts on organic single crystals.

(1) Select a proper organic crystal from a batch by examining the contents of the container under a zoom optical microscope with a large working distance (use a dim light to minimize possible photo-oxidation of the crystals). For the purpose of making free-standing single-crystal OFETs, bar shape crystals are preferred. Since the surface of the crystal is extremely important for OFET electrical performance, the crystals that have flat and shiny surfaces are desirable.

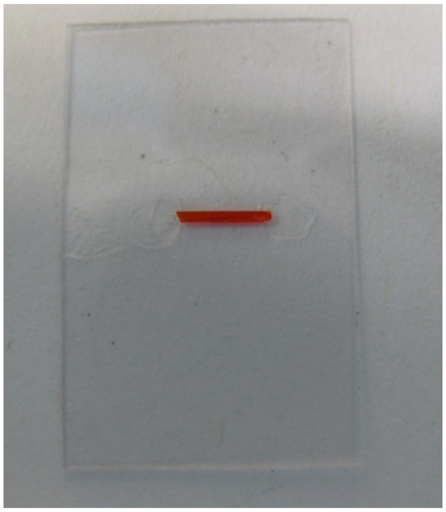
2) Prepare a glass or plastic substrate of the right size that will support the crystal. The substrate should easily fit into the parylene deposition tube (if you plan depositing parylene on these samples), which in our case has ID = 19 mm. If you plan to perform measurements of these samples using a small sample holder (such as the one in our low-T dipstick system or the He-4 Oxford cryostat), make sure the substrate will fit to the sample holder. For room temperature measurements, our substrates are usually 1x1.5 cm^2 in size. Clean the substrate with a proper solvent (acetone for glass, isopropanol for plastic).

3) To transfer the selected crystal from the sample container to the substrate one can either use a sharp-tip precision tweezers or make a tiny "scoop" out of thin weigh paper that can be used to pick up the crystal (see the photo below). Normally, organic crystals are very brittle and can be easily crushed or scratched, so extreme caution is necessary to master the crystal handling. Once, an appropriate crystal is transferred to a clean substrate, make sure it's selected facet is looking up.

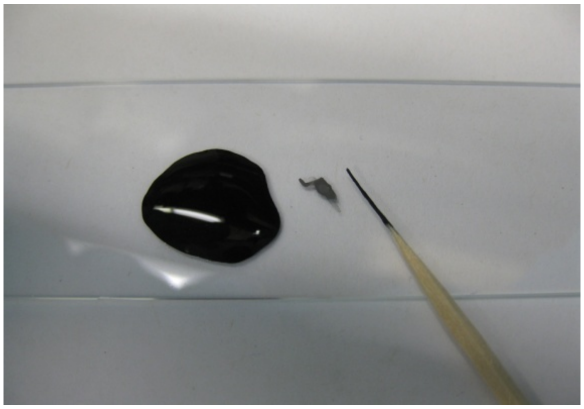


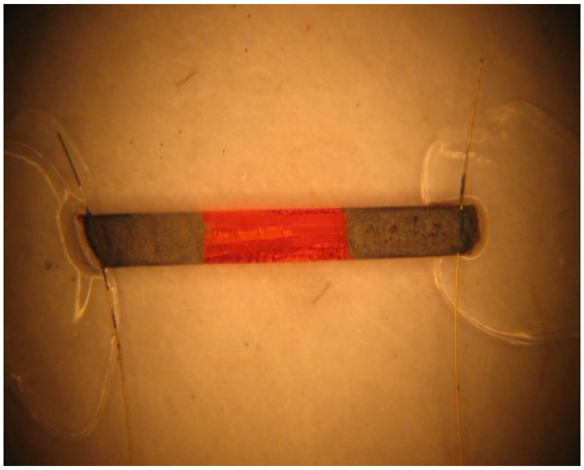
4) In order to paint graphite contacts, first the crystal has to be attached to the substrate to prevent it from moving back and forth during the contact fabrication. The best way to attach the crystal is to use a very small amount of rubber cement (silicone rubber glue that remains a little flexible even after drying). Some other glues can also be used. Using a wooden tooth-pick sharpened with a razor, apply a tiny droplet of glue to the substrate surface, and then gently push the crystal using tweezers in the direction of the droplet while looking at it through the microscope. Once a corner of the crystal touches the droplet, stop moving it. Wait a few minutes for the droplet to solidify. Then, apply another very small droplet to

the opposite corner of the crystal, so that the glue binds that side of the crystal to the substrate as well. Usually, such two-point fixation is sufficient for further work on the crystal (see photos below). It is not recommended to glue down the entire back side of the crystal. You should avoid getting the glue on top of your crystal to prevent surface contamination.

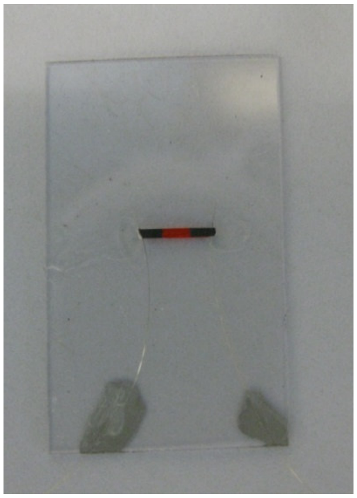


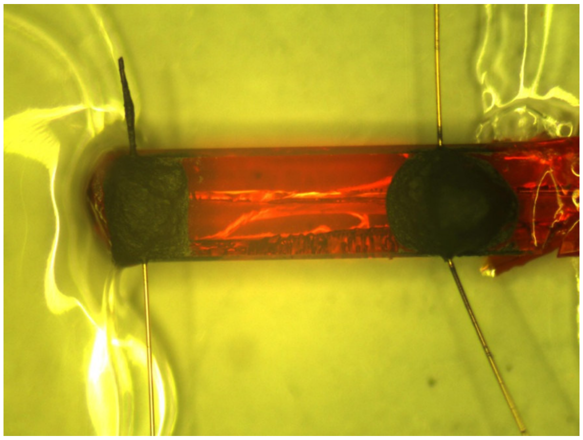
5) Deposit source and drain contacts by using either colloidal graphite or conducting silver paint. Graphite paint is preferred, because it makes a lower-resistance contact to most of the organic crystals. Water solution of colloidal graphite works the best (it can be diluted in DI water, if necessary). Always thoroughly mix and ultrasonicate graphite paint before each use. To deposit graphite contacts, first prepare a wooden "brush" for applying graphite paint to the surface of the crystal. Use a razor blade to thin down the tip of a wooden toothpick and then slightly bend the tip without completely breaking it off. This kind of Γ–shape tool made out of a toothpick is convenient for application of graphite paint. Normally, surfaces of organic molecular crystals are very hydrophobic. Thus, applying aqueous graphite paint is not easy. The droplet of the paint will roll up without spreading along the surface. Sometimes it is hard to even leave the droplet at the surface. In order to make it stick to the crystal surface, use the wooden toothpick tool to pick up a small drop of graphite paint, then gently touch the crystal surface where you want to make the contact (while looking at this through the microscope) and then rub this spot lightly by moving the toothpick tool back and forth, until you see the graphite paint spreading. The wet layer of the graphite paint at the crystal surface should be uniform and non-transparent black. Quickly after that, pick up a 1-2 inch long piece of 25-μm gold wire with tweezers (these pieces should be prepared beforehand and conveniently left handy under the microscope, next to your sample). Always look through the microscope while performing all these procedures. Stick one end of the gold wire into the wet graphite contact, observe the wire being wetted by the graphite solution and let it go. Let the contact dry. You can now add a little more graphite paint over the wire to make the attachment to the crystal stronger. However, make sure not to put too much paint, because it may cause the contact to be too thick and eventually detach after drying. Make two of such contacts, with a nice area of the crystal between them – these will be your Source and Drain contacts.





6) The opposite free ends of the gold wires should be affixed to the substrate to minimize the strain exerted at the source and drain graphite contact pads, when a mechanical force is applied to the wires. To do that, use silver paint to affix the gold wires to the substrate in two points (see the photo below). These conducting contact pads (sitting on the insulating substrate) can now be used to make a contact by external pins, spring-needles or other wires, to connect the sample to the external equipment.





In this form, the sample is ready for either (a) parylene deposition to form a gate dielectric layer, or (b) 2-probe (photo)-electrical measurements. Remember that if parylene deposition is performed, the free ends of the gold wires (or the contact pads) must be carefully stripped off the parylene film using a razor blade under the microscope, because parylene coats everything conformally. Technical notes on *parylene deposition* can be downloaded from our web site as a separate file.