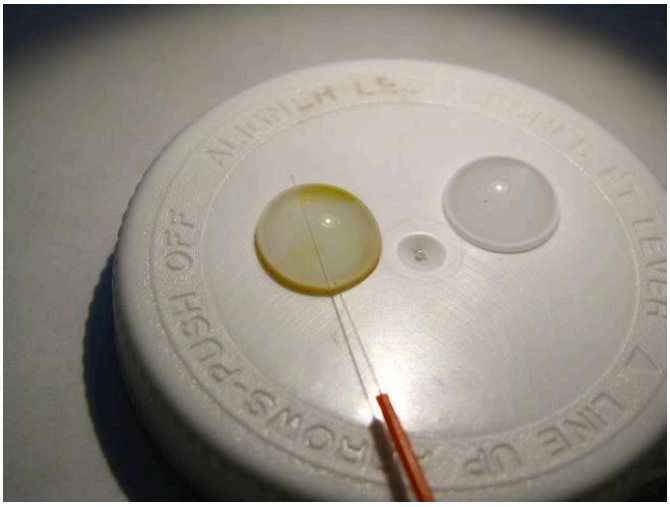
Drop mixing system for wet optical fiber coating in a drop

Main Goal

The silver (wet) optical fiber coating in a drop requires mixing a water-based silver solution within a much larger water-based glucose solution. We have observed that solutions don't mix well in a drop. The goal is to design a drop mixer. One idea is to excite the drop using should waves.

The drop on the left: a mix of silver and glucose solutions during the wet optical fiber coating process. The yellow color is precipitated silver



Trial 1 and 2

Date: May 31, 2012
In attendance: Tibi
Location: Montreal labonline / CTS
Topic: Drop Mixing

See pictures taken documenting this Work.

Goal

See if we can mix a drop using sound waves. The idea is to place the drop on a plane surface, which is excited by a microphone. We hope that we can find a proper frequency and amplitude to have the drop mixing.

Materials and setup

For excitation

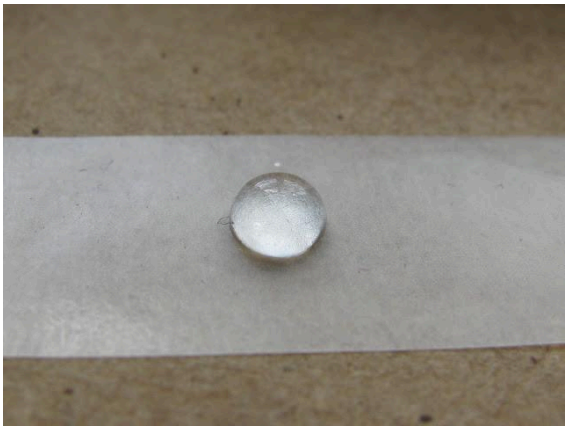
We used a speaker extracted from a laptop computer. We modified this speaker by adding clamps to hold a glass cover slide on which we'll place our solution drops to be mixed - for optical fiber coating. The speaker was driven from the speaker out of a computer, and the frequency and amplitude were precisely selected with the help of a LabView program made for this purpose (see Tibi). A small piece of PLC was glued on the membrane of the speaker with silicon glue, to have conduct mechanical vibrations from the membrane and the glass cover slide that will be placed on top of it, see below.

The speaker with the PLC glued on its membrane

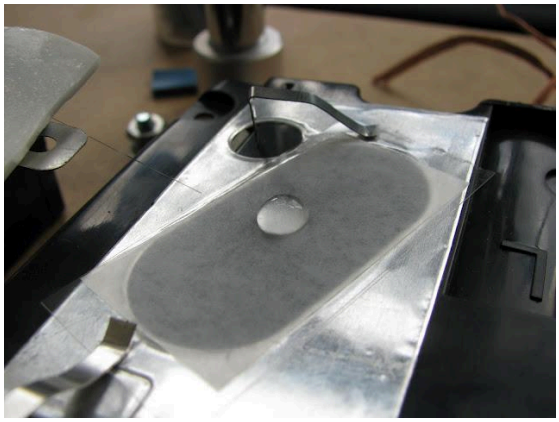
Support for the drop

A very thin (250 microns) glass cover slide was placed on top of the speaker in contact with the small PLC piece glued on the membrane of the speaker - see above. The clamps were used to hold the cover slide in place.
We tried a small piece of hydrophobic wax paper as surface in contact with the water-based drops. The wax paper was fixed to the glass cover slide using the surface tension generated by a meniscus of water in between them. The drop sits well on the wax paper, but we realized that this type of wax paper was porous. We used a normal brand of kitchen wax paper.

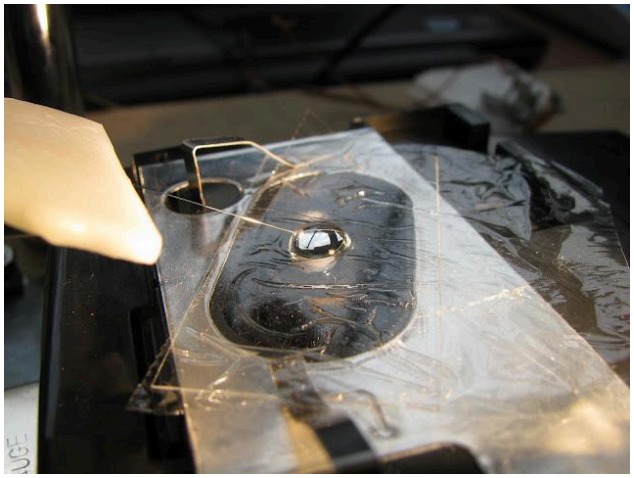
Water drop sitting on a piece of wax paper



The water sitting on the wax paper, which sits on the glass cover slide, which sits over the speaker, mechanically connected to the membrane through a small piece of PCL



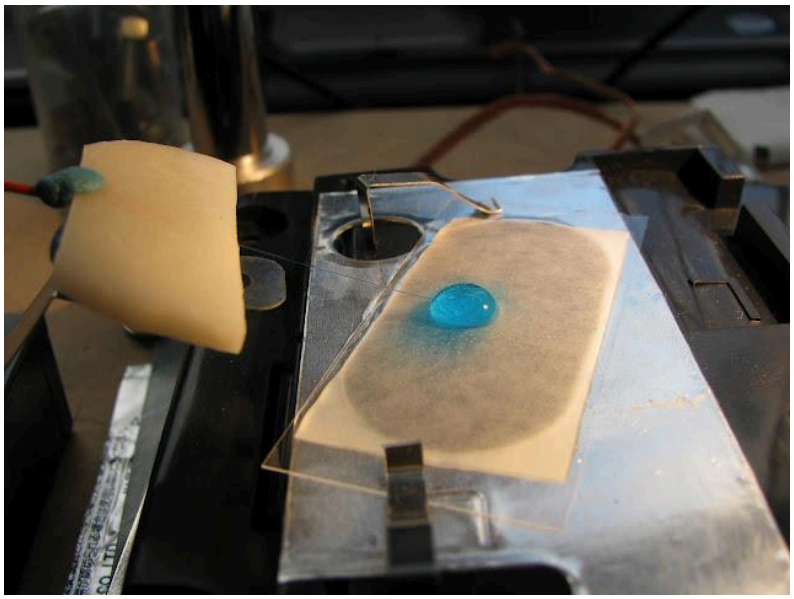
We later replaced the wax paper with a thin surround wrap foil.



Fluids used

We used water and glucose (the same solution of glucose normally used in the wet/silver coating process) for the large drop, and a small drop of food coloring.

Similar to the previous picture, but a small drop of blue food color was added to the larger drop of glucose. On the left we can see the optical fiber going into the drio



Summary of results

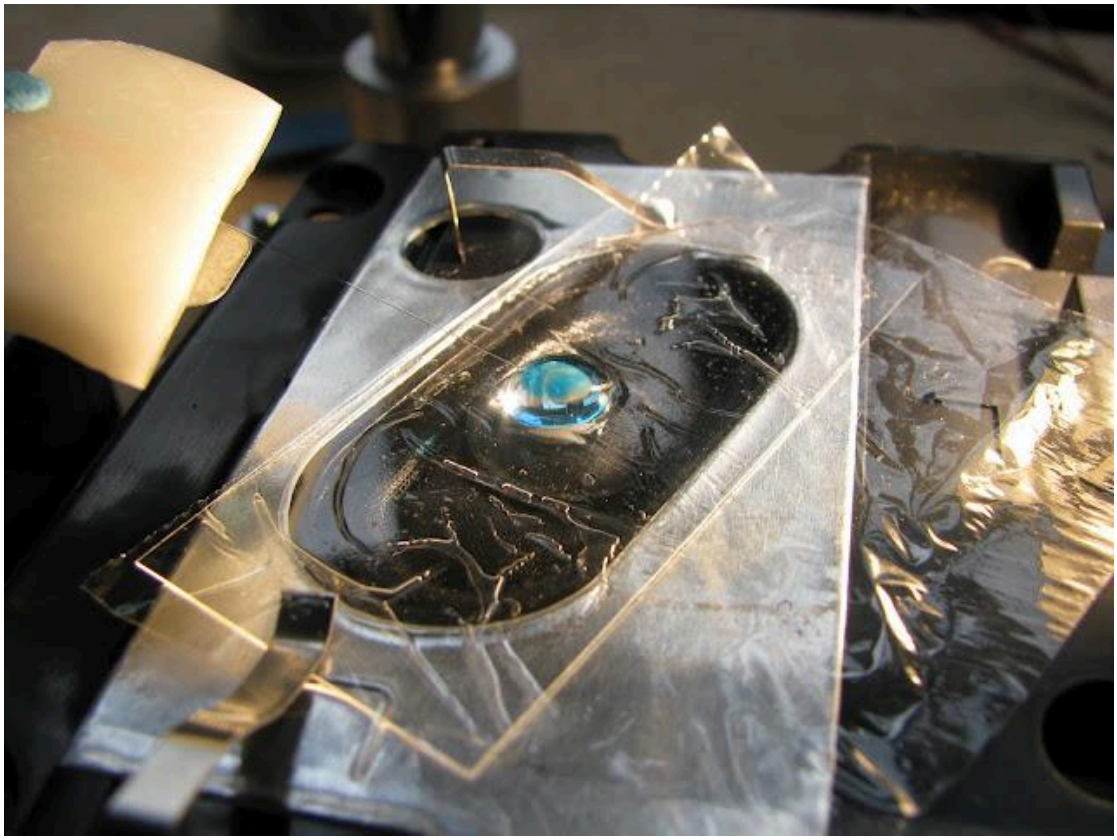
See pictures taken documenting this Work.

The wax paper used in this trial was leaky, but we liked how it maintains the water-based drop

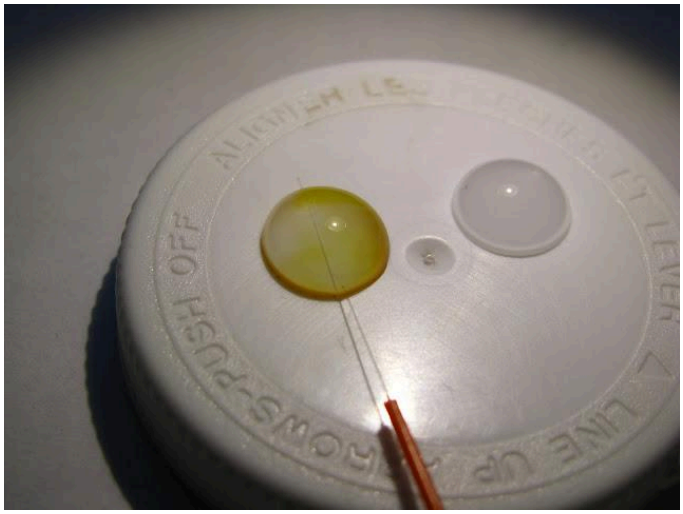
on it. The surround wrap worked well, but doesn't do a good job for pictures and videos, because it is transparent. Images look better on a white background, offered by the wax paper. **Need to choose a different wax paper.**

Only single-frequency signals were used in this trial. We found some frequencies that mix the drop effectively at the proper amplitude. Not all frequencies are good, only multiple of 30 Hz were appropriate. The best mixing was observed at around 125 Hz. The movies we took were not very good quality, we'll make other ones. The two parameters, frequency and amplitude, depend on the size of the drop. Pattern formation at the beginning of the mixing process was also observed, which is normal, because we were exciting standing modes. We need to modify the LabView program in order to be able to excite with signals composed of multiple frequencies, to make the drop vibration more chaotic. We'll play with amplitudes, frequencies and phase. We need to find a good mix of those. 2 or 3 waves can be enough.

Glucose drop after we added a very small drop of blue food color. The two don't mix, and can remain in this state for minutes. We've seen the same effect when adding a small drop of silver solution to the larger glucose drop - see picture below.



Drop on the left - Inhomogeneous mix of silver solution and glucose solution during silver fiber coating. The yellow color is precipitated silver. Drop on the right - a drop of glucose solution.



Conclusion

- **Need to try a different wax paper.**
- **Make a good video showing the mixing and the effect of frequency and amplitude.**
- **Modify the LabView program to send a mix of frequencies and find sets of parameters of amplitudes, frequencies and phase.**

Other documents

- Optical fiber silver coating - work parties
