POLARIZATION REVISITED

There are all kinds of specialized microscopes. Some are made specifically for mineralogy; others are to look at gems. There are inverted microscopes and right side up microscopes. Phase contrast microscopes and Differential Interference Contrast, or DIC for short, can be added to the list. Amateurs can't have them all, so we have to make do. One can buy kit lenses and condensers to convert a standard microscope to do phase contrast microscopy. Another easy conversion is to add polarization, but it can present some problems.

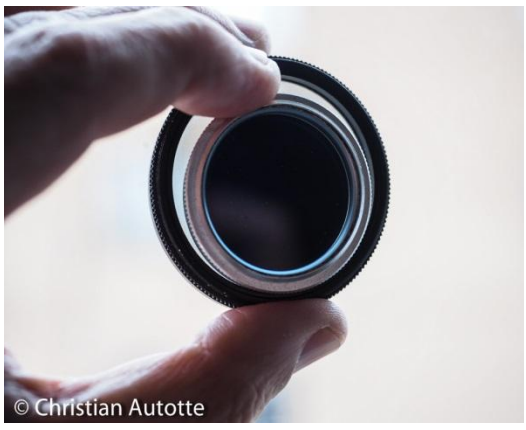
The principle is simple enough: you first place a polarizer on top of the light source. A second polarizer must stand somewhere in the light path above the preparation being observed. With low magnification lenses, it may be possible to simply place a filter right on top of the slide, but this simple solution quickly becomes impossible at larger magnification as the space between slide and microscope lens becomes too thin.

A specialized polarizing microscope usually has an "analyser" inside its head and a polarizer incorporated to its light source. The analyzer can be rotated to change the effect. But adding a rotating analyzer to an existing microscope head can prove difficult or even impossible. The solution is to rotate the filter over the light source.

Most microscope head can be removed easily. My three main microscopes, an Acuter, a Kyowa, and a Zeiss Standard have heads that can be removed with a simple thumbscrew. The space beneath the head is spacious enough to accommodate a filter, even with the ring normally used to screw it on a lens. In worst case scenario, it would be possible to dismantle the filter and keep only the glass. While there are polarizing filters film, these plastic sheets are not optically good enough to be placed between preparation and eyepiece; at best they could be used over the light source, but they are somewhat fragile and scratch easily.

Polarizing filters used in photography come in two main categories: linear and circular. Modern cameras use the circular polarizers; otherwise their metering and autofocus systems can perform erratically. Some sources suggest that linear polarizers are preferable for microscopes, but I have used circular polarizers in my modifications.

These two filters do not cross-polarize properly; try reverting one of them or try another pair.



Cross polarization is achieved when two filters placed on top of each other turn black.

Not all filters will work. Being a photographer, I had a rather large collection of filters at my disposal. So I tested all possible combinations to find the best pair. In some cases, the cross-polarization effect was too weak or quasi non-existent. When that is the case, always try reverting one of the filters (placing it upside-down); sometimes it works better. My favourite pair does not polarize to the point of turning the background pitch black; instead it renders it a deep shade of blue.

Once I found the best pair, I placed the smallest filter inside the microscope head; it stays there permanently. Yes, there is a slight loss of light when the microscope is in normal use, but the amount is negligible.

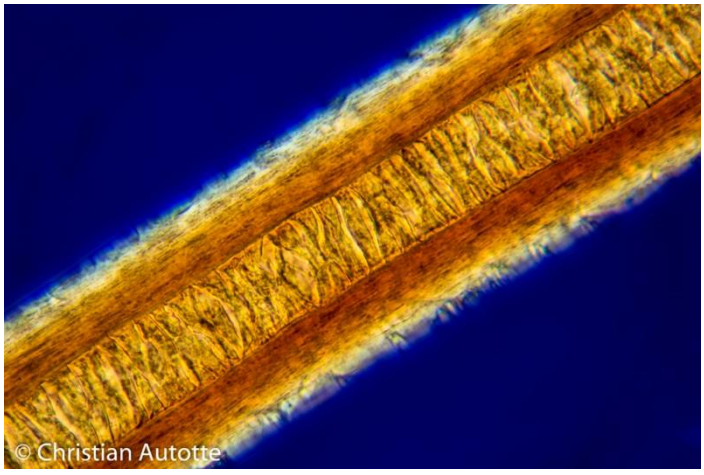
The filter in the head would normally be the analyzer, and has mentioned it would have the option of being rotated. That option is now with the second filter placed on top of the light source. So far, I simply place the filter on top of the light condenser; in the future, I might glue a ring on top of it to screw the polarizer in place, but it's really not a necessity.

A small lens filter dropped in place under the microscope head, leaving plenty of space; otherwise I would have mounted the glass by itself.

The second filter, placed on top of the light condenser.

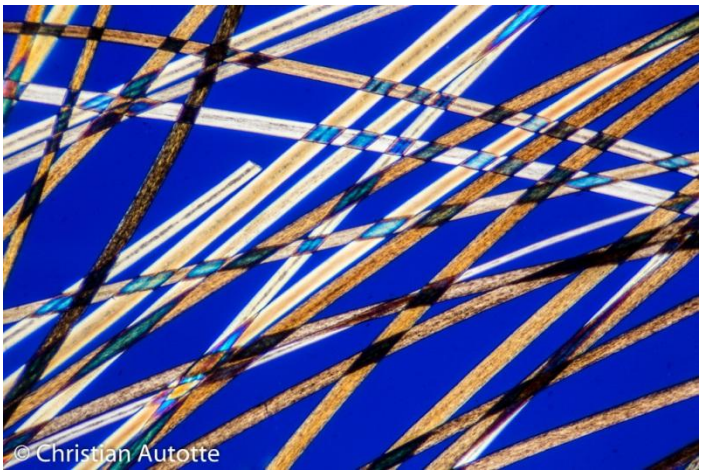
The list of subjects that can benefit from polarization is limitless. Any types of hair stand out and show details that can't be seen in normal light. Some feathers are interesting, others don't polarize well. Insects are also a favorite. Many plant tissues, especially stained preparations, can reveal surprising colors. And of course, there is the old standard of polarizing microscopy: crystals. There are plenty of articles in Micscape about crystals to keep one busy for weeks…

You can't always trust your eyes in polarizing microscopy. At times, visual observation may seem disappointing, but a photograph can capture more light and colors so that the final picture will often come out a lot better than anticipated. In other circumstances, it may be useful to either rotate the filter or rotate the subject. As with many things in amateur microscopy, it pays to experiment!

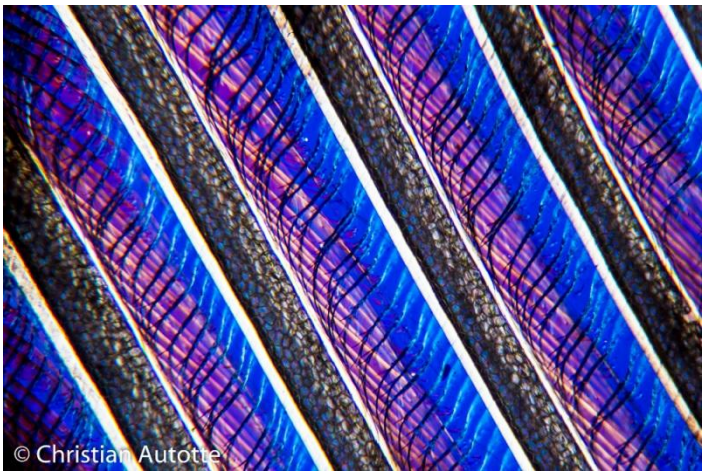


Black Bear hair

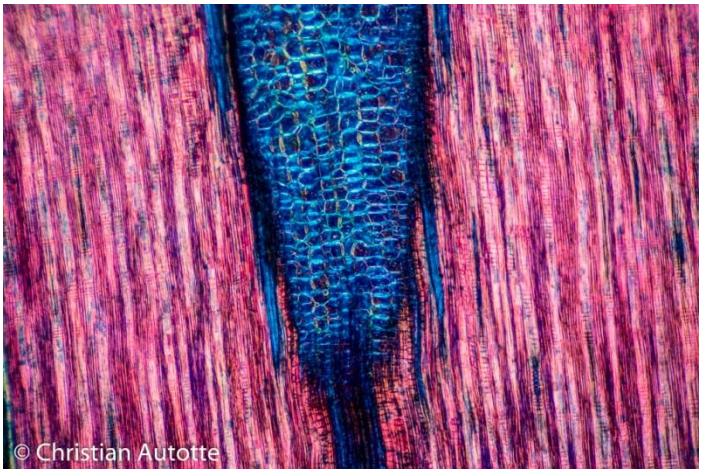
Whitetail Deer hair roots (composite)



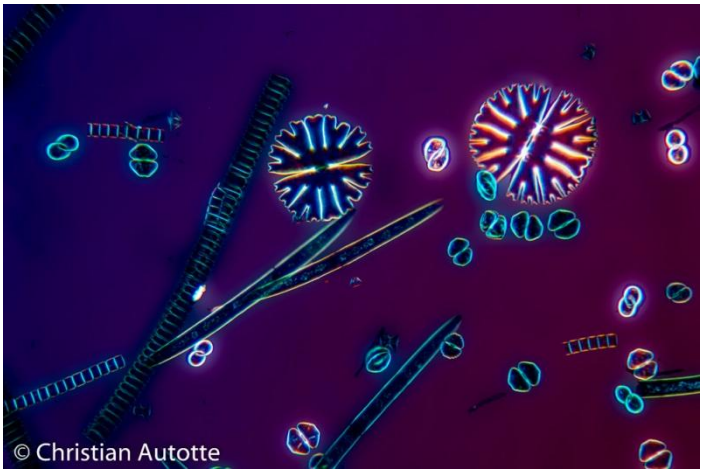
Human hair



Ruffed Grouse feather



Poplar stem



Mixed desmids

Honey bee rear leg

Wolf Spider foot

Comments to the author Christian Autotte welcomed, email: cautotte.9001 AT videotron DOT ca

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