

## A beginner's journey into microscopy with a little help from a 3D printer!

I used to be a fairly active amateur astronomer with a particular interest in spectroscopy mainly observing emission and absorption lines from stars but the unpredictable UK weather coupled with endless cloudy nights eventually made any sort of observing difficult to say the least and gradually over time I observed less and less.

I am a member of an active astronomy forum in the UK and they have a small sub section on Microscopy (for members) and a casual glance at posts on there sparked an interest in me and I went from observing the very large to the very small. Thinking I didn't want to spend a lot of money on (yet another - my wife!) hobby a glance around eBay came up with a nice Leitz Laborlux S compound microscope complete with 5 Leitz objectives. These items are very much 'Buyer beware' like a lot of items for sale on eBay as they are usually just sold by people who buy job lots of items but it turned out that my purchase was a very good one which I received a week later.

Leitz Laborlux S



After playing with the scope for a while it became apparent to me that the mini supernova masquerading as a halogen lamp on my scope generated that much heat that for the safety of my desk I very soon after converted it to LED lighting.

LED dimmer



LED



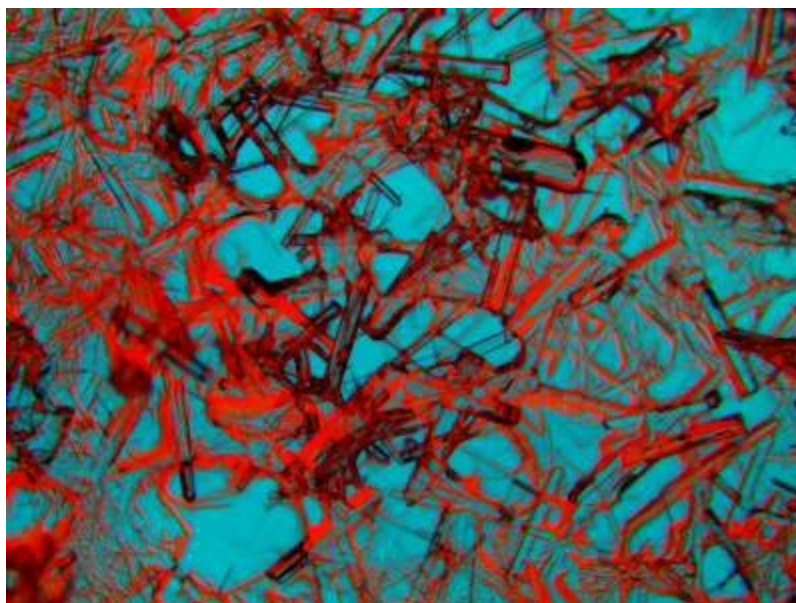
Looking through mags like *Micscape* I came across some excellent articles by contributors like Richard L Howey and James Stewart on crystal growth and imaging under crossed polarised light which interested me greatly.

I also came across Rheinberg filtration and how to change the background/foreground colours of the crystals on the slide. I read an article about making these on a printer and so ordered some Acetate and with the printer set to photo quality set about designing some to fit the slot on my condenser and they seem to have been quite successful.



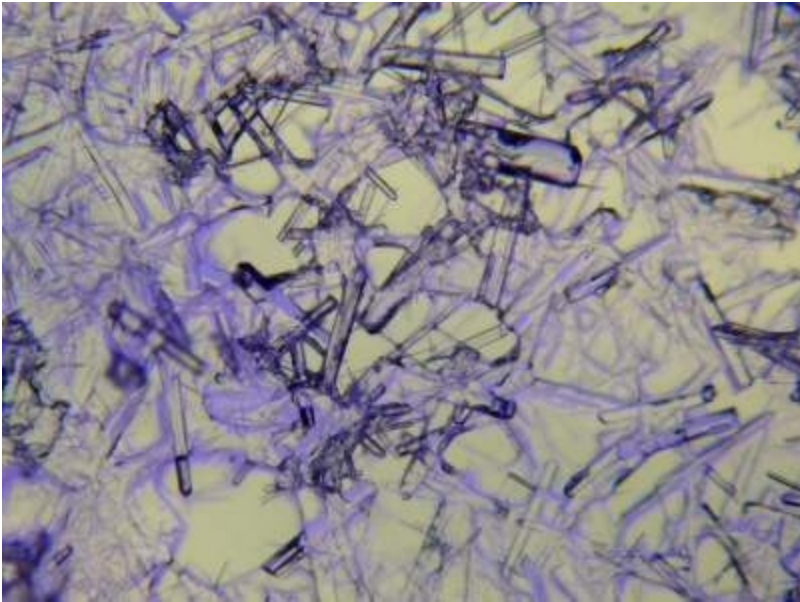
and using various combinations on the same slide eg:

Light blue/red

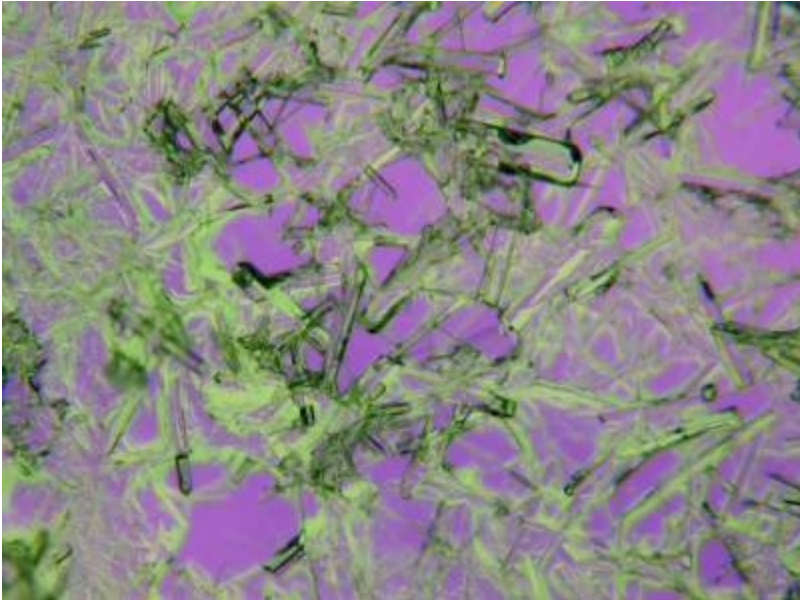




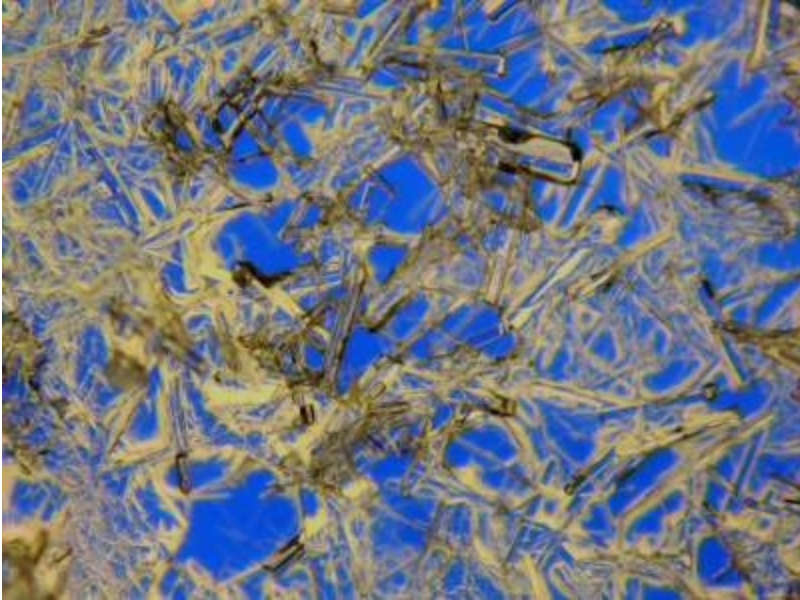
Peach/purple



Purple/yellow



Blue/yellow



A small 5meg Toupcam camera was next acquired to image on my pc. My Leitz scope had a trinocular photo tube setup and the Toupcam slotted nicely into place inside this and this setup has given much enjoyment being able to image crystals using the Toupview software but also I have been fortunate to be given a license to beta test some software called Altami Studio which enabled me to focus stack and other different operations using my camera.

Toupcam



It was at this point I noticed other microscope users imaging using their DSLR cameras and wondering how to adapt my now little used Nikon D5500 DSLR to image with my Leitz scope led me down the 3D printing path!.

Now 3D printing had had me interested for a while but not knowing much about it and this seemed the perfect opportunity to get one and see what all the fuss was about and with Xmas on the horizon “what would you like for Xmas?” from my dear other half was easily answered.

After some research a Creality Ender3V2 printer was duly ordered/delivered and assembled and after a play with the supplied filament with files on SD card I managed to print off my first 3d models.

Pic of little dog, Filament (filament- geddit?) and cube.



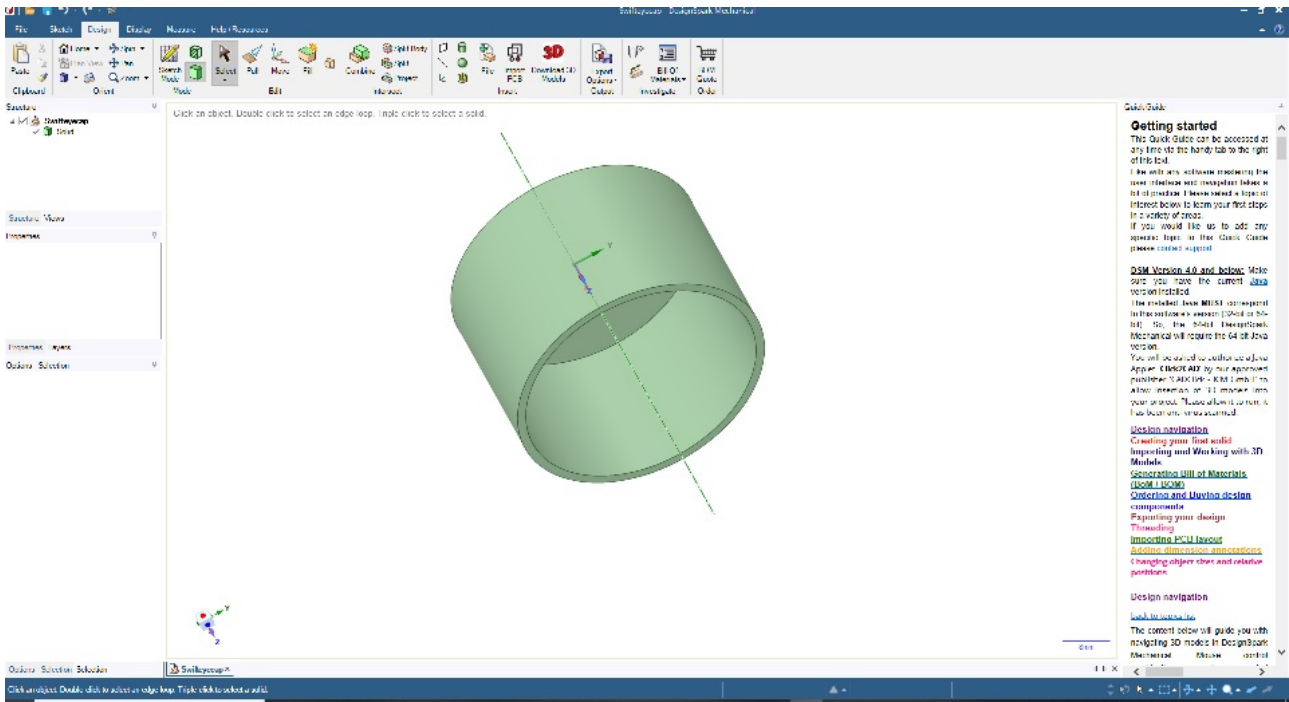
Now my thoughts returned to microscopy and realising that the various odd size adaptors I had in mind for use with the camera would not be available online my next step was to checkout ways of designing these things to my own specs which then led me down the Computer Aided Design (CAD) path and after trying out a few applications eg FreeCad, Fusion 360, Tinkercad etc I came across an excellent free application called `DesignSpark Mechanical`.

3D models can be designed on the pc and the file is saved as an .stl file eg eyepiececap.stl.

This file is then entered into another free app called a Slicer which is configured for your own actual printer this in turn creates another `gcode` file eg eyepiececap.gcode and it is this file which is sent to the printer and with an Ender 3V2 this is done via SD card.



# Screengrab of DesignSpark Mechanical (an eyepiece cap).



Compound scope caps.



Stereo scope caps.

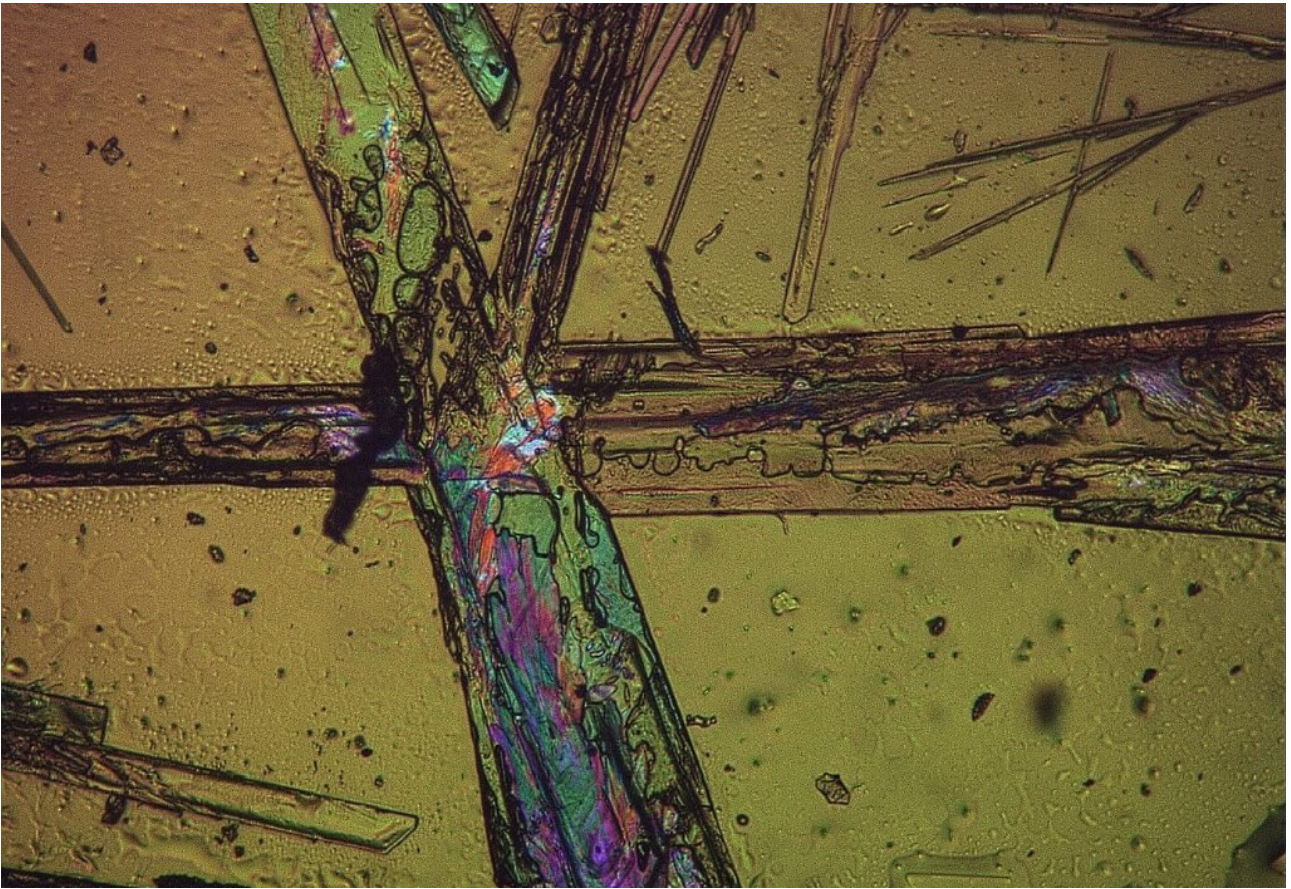


Now I envisaged all sorts of imaging setups and I still had some excellent astronomy cameras I thought I might have a go at using them although my CCD camera is an Atik 314L 16 bit cooled camera which has onboard cooling to reduce electronic noise but its a mono (ie black & white) CCD which although the norm with astro imaging is not really practical for use at the microscope as it requires 3 separate images through Red,Green and Blue filters which are combined via software to get a single colour image - not much use on moving critters but it was interesting to try and yet again the 3D printer made connecting it possible.





Combined red, green and blue image.

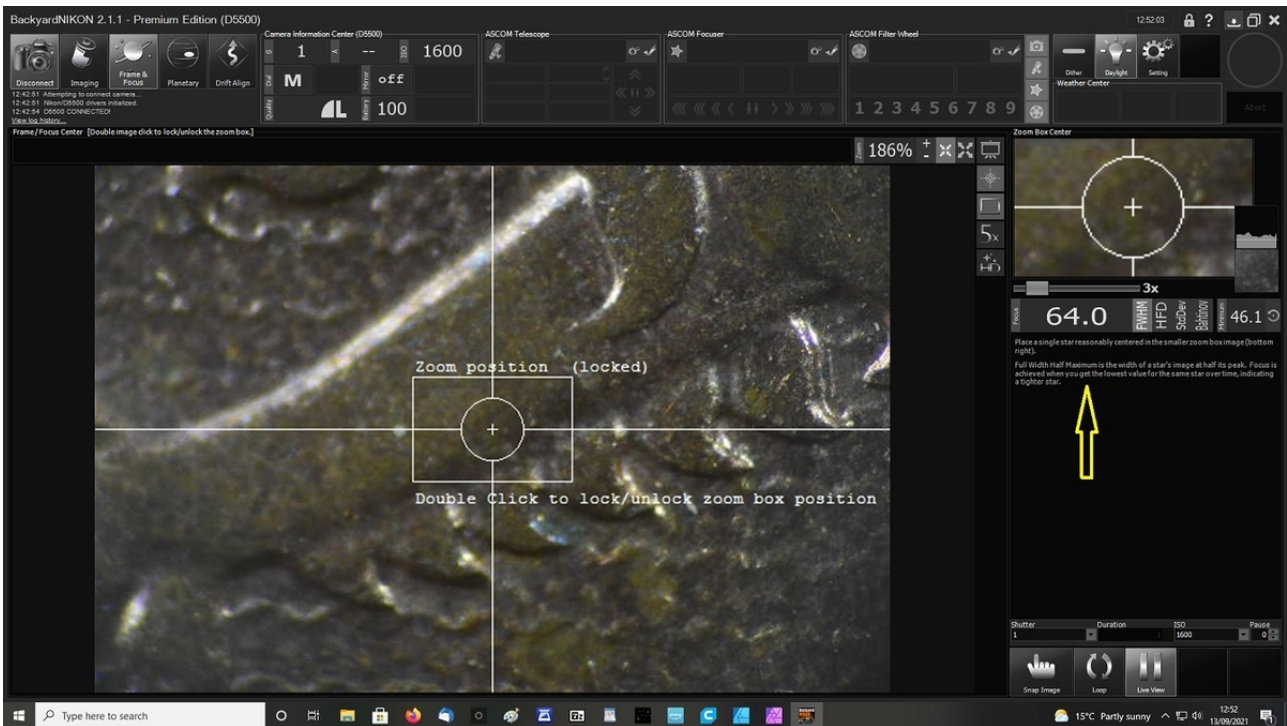


More adaptors were produced via DSM and the printer for using the DSLR both with and without an internal x10 photo eyepiece and using some Nikon tether software (called BackYardNikon) which I used at the telescope proved very useful especially with focusing as it had some excellent tools such as FWHM (full wave half maximum)

One of many DSLR adaptors.



A screengrab using BackYardNikon of a coin with pointer to FWHM used for focus.



As well as adaptors for the microscope my family have now taken an interest and other things are now being produced for the grandchildren.



Fun prints

Meet Groot.





Wall art.

The four elements apparently, Water Wind Earth and Fire.



Even Senator Bernie made an appearance.



Adaptor anyone?, many more were disposed of.



The square grey box on the right is a 3d printed spectroscope!.

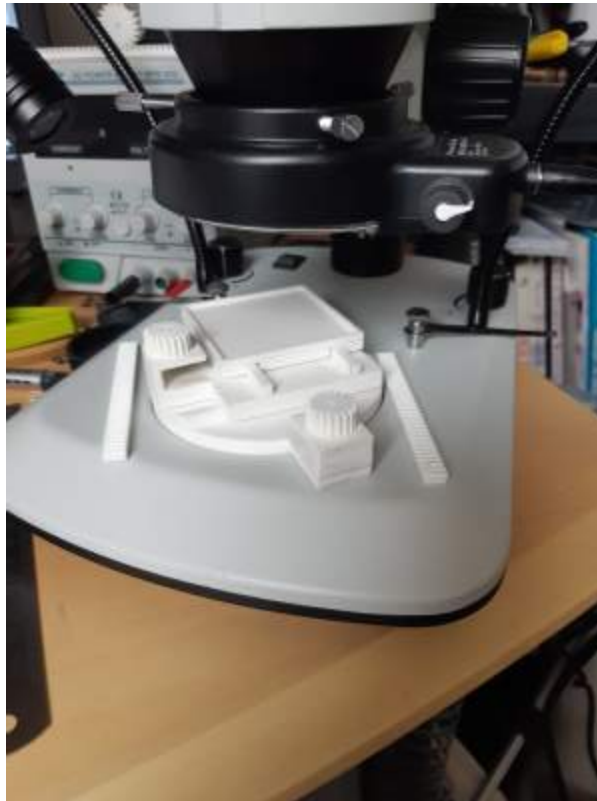
Pic of rotating stage for the compound scope.



I'm presently designing a rotating x-y platform for my new stereo microscope which I designed again with DSM and I found on Thingiverse some stl files on rack and pinion gears which are proving useful for this project.

I know you can buy all these things or get them made but I don't think there is anything quite like the thrill of thinking up an idea and seeing it through to completion and holding the finished product in your hand.

The project so far, this is mk3 and many iterations are made before I'm happy with it! This just slots into a 95mm diameter recess in the base of the scope.

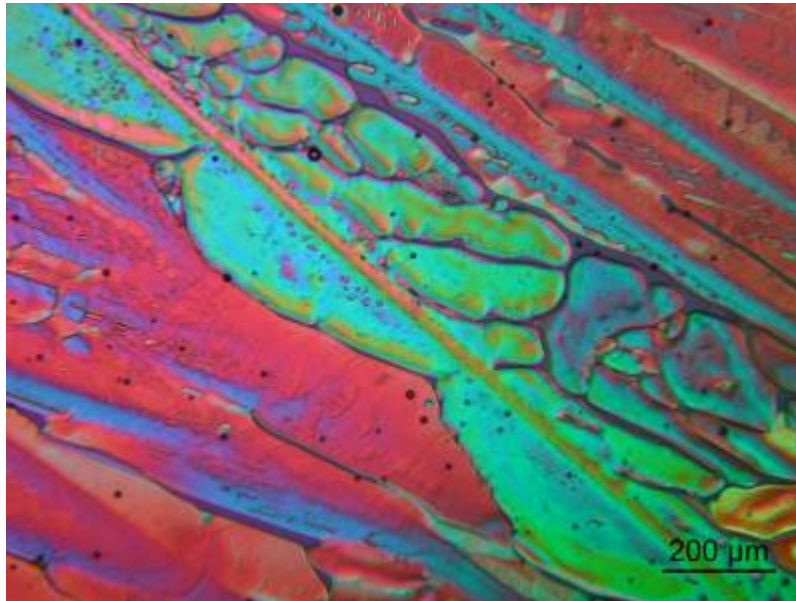


I now seem to be finding with Microscopy (like I did in Astronomy) you can go off on so many tangents to other things.

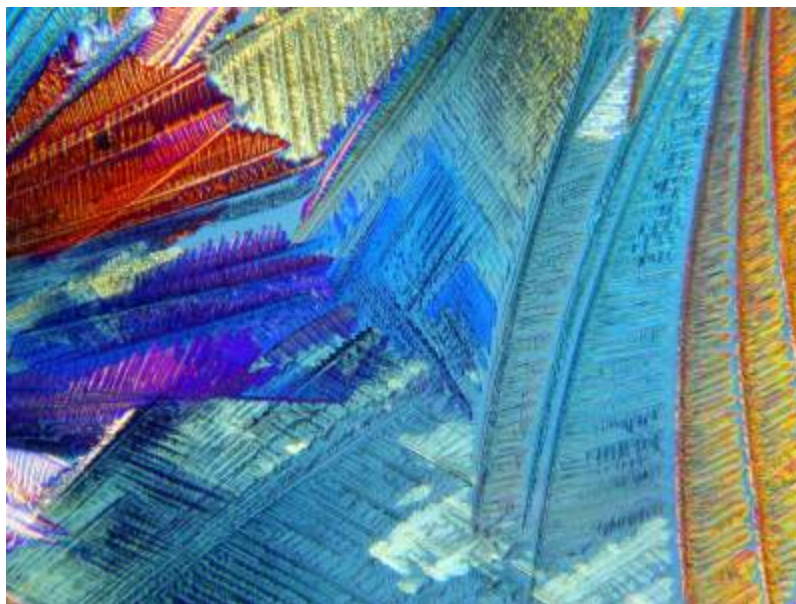
I have recently become interested in painting and in particular abstract art and thinking that the images from crystals may prove a source of inspiration.



Some beta Alanine for instance (this is from the microscope and not a painting!)



and some Glycine mixture.



I do think 3D printers will prove a real boon for many hobbies. You really are restricted by your own imagination (and the limits of the printer of course ;-))  
I would like to thank one Bogdan Alecsa who I came across on Facebook for kindly sending me his stl files for the polar film holders for my Leitz microscope which enabled me to create my first crossed polarised images of crystals!

Hope you enjoyed the article

Steve Cuthbert (UK), email - [stevecuth14 AT virginmedia DOT com](mailto:stevecuth14 AT virginmedia DOT com)

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