Cross-Polarization in Epi-Illumination

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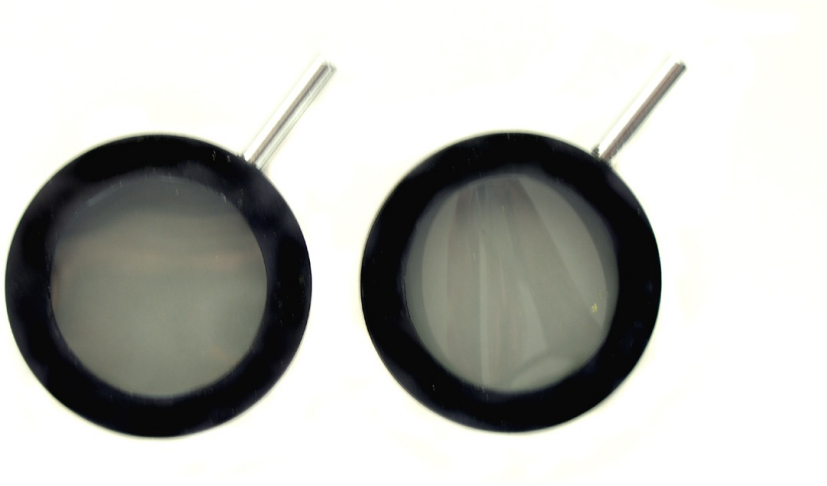
I received an e-mail in response to my recent review of an Amscope metallurgical microscope asking if I was aware if Amscope provided any filters for cross-polarization with epi- (axial-) illumination. I wrote back saying that I wasn't aware of any such filters, but it should be simple enough to set up a scope for cross-polarization by putting a polarizer at the filter tray near the lamp house and putting another polarizer between the top of the illuminator and the viewing head to act as the analyzer.

Suffering from the curiosity commonly afflicting microscopists, I thought I would give it a try.

I ordered a 5x5 inch sheet of polarizing film online to cut to size for the polarizers and analyzer. The thickness of the material was 0.13mm, about the thickness of a cover slip. When two pieces of the polarizing material were cross polarized, the result was almost total extinction of the light passing through.

Since I couldn't find any use for the Amscope green and yellow filters that came with the metallurgical scope, I removed the glass filters and replaced them with polarizing film cut to size. Since I had two filter holders, I made an East-West and a North-South filter.

Tech tip: to cut the film to size, I sandwiched the polarizing film between the two glass filters with a plastic spring clamp and trimmed the edges with a large toe nail clipper.

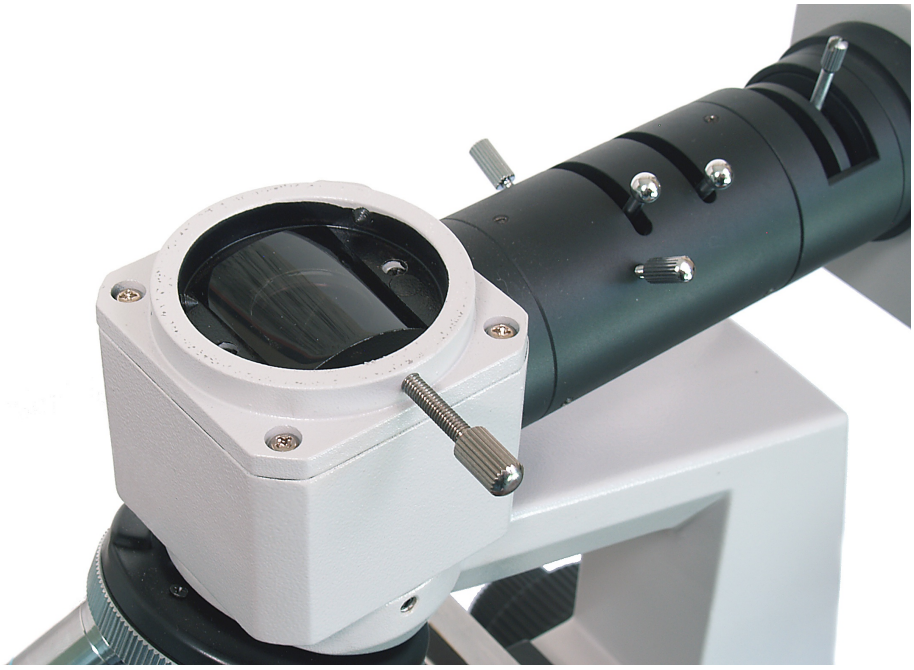


Each of these filters would be placed in the filter holder at the exit opening of the lamp house of the illuminator as shown here:

Since the East-West and North-South effectiveness is relative to the orientation of the analyzer, determining which polarizer will be the most effective could be found simply by testing each polarizer against the analyzer once it is mounted.

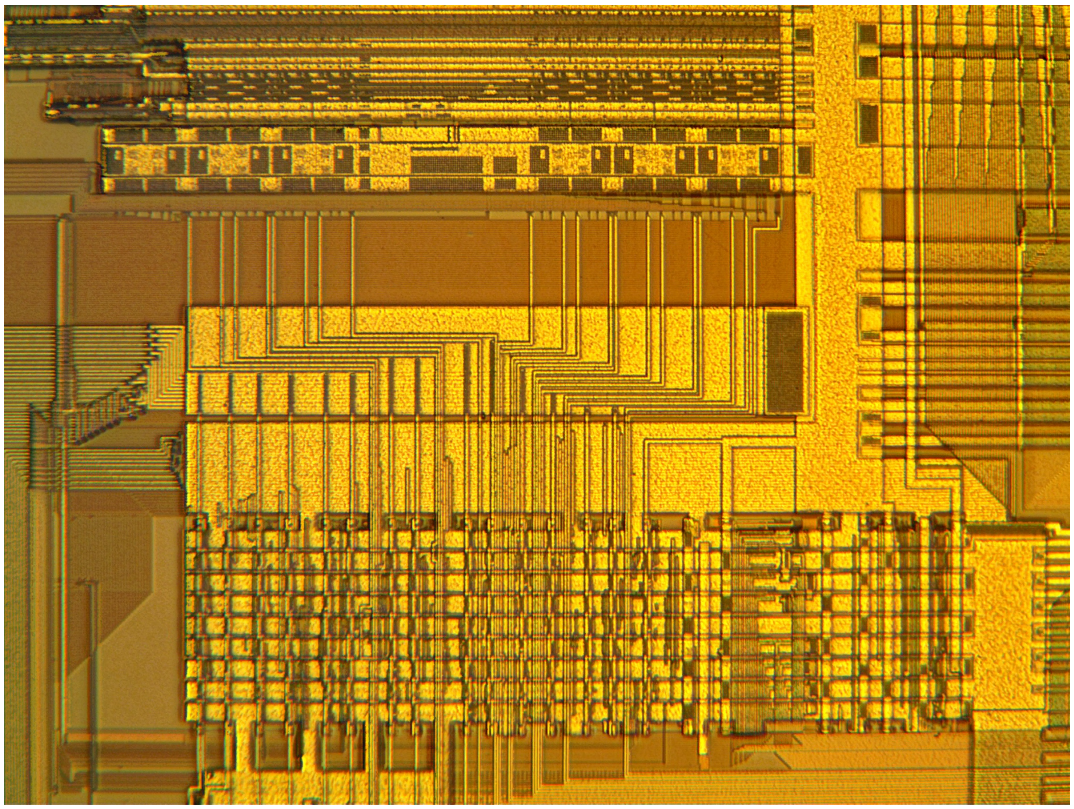
To mount the analyzer, I removed the trinocular head from the dovetail mount.

Then I simply dropped in the size-cut filter onto the top of the illuminator.

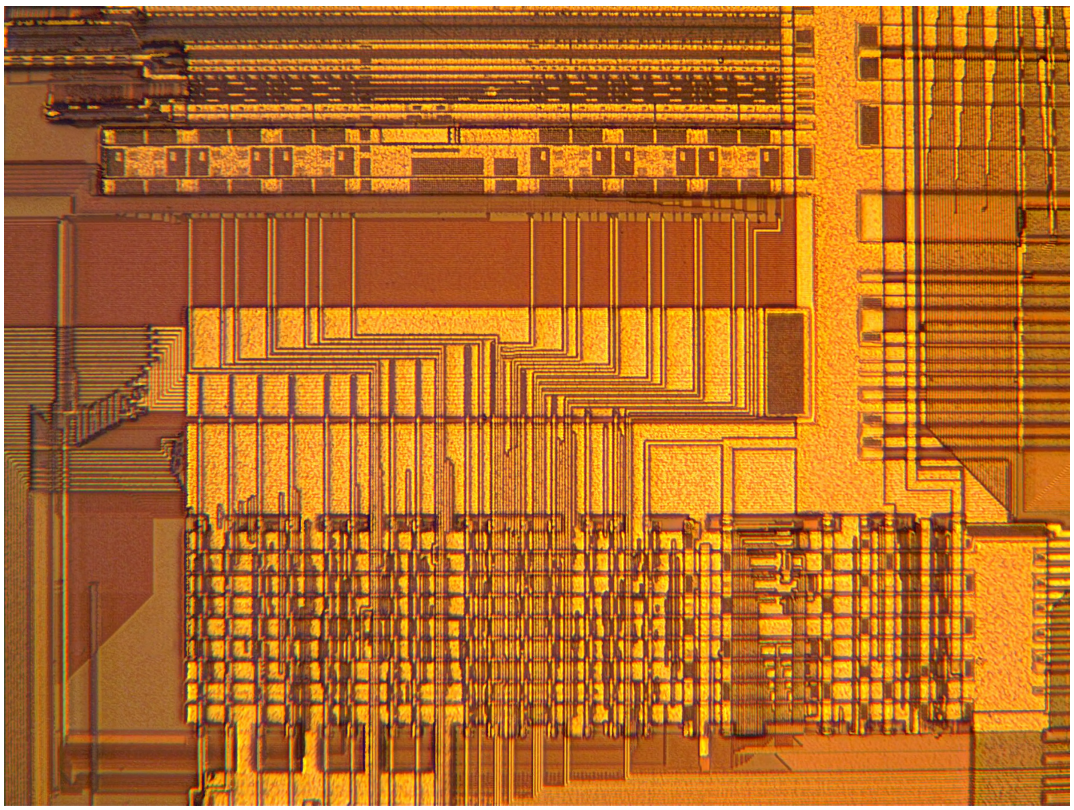


When the viewing head was replaced, it flattened the analyzer polarizing film.

This is an image of an Intel Pentium I microprocessor in brightfield illumination



This is a cross-polarized image of the same subject:



When viewed through the binocular eyepieces, the polarizer at the lamp house on the illuminator was rotated to the point where there was almost total extinction of the image. Then the exposure was adjusted in the ToupView software that supports the CMOS camera to about 0.3 seconds to compensate for the darkness of the image.

The value of cross-polarization with epi-illumination is that it reduces reflections from edges of opaque subjects that would otherwise diminish detail and contrast as seen in brightfield axial illumination. This is particularly true of micro-electronics, since they are made up of layers of etched surfaces.

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Bibliography

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