OXIDE AND SULFIDE INTERFERENCE FILMS ON COPPER

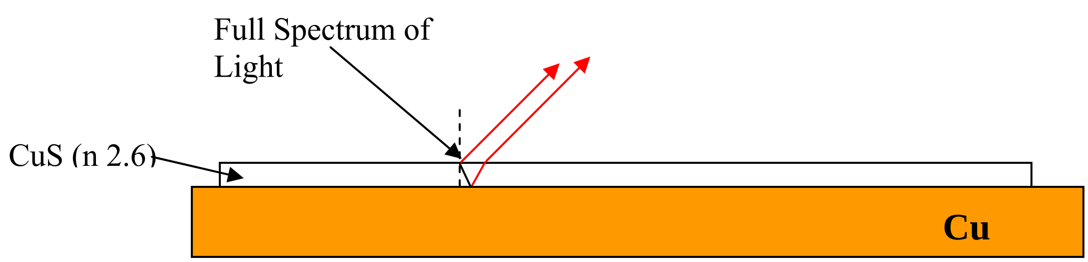
Light is reflected off the surface of the film, and is reflected off the surface of the copper. The light that enters the film is refracted ala Snell's law and is shifted in phase relative to the light reflected at the surface of the film (CH 4 in the Analytical Light Microscopy book). The two beams of light now interfere with one another. CuO and CuS are actually black but when the films are very thin they show interference colors which darken with the thickness of the film. The formula for figuring out the thickness of films is:

1st Minimum at $D= \lambda/4n$ *This formula gives you the point at which the color for that wavelength disappears.*

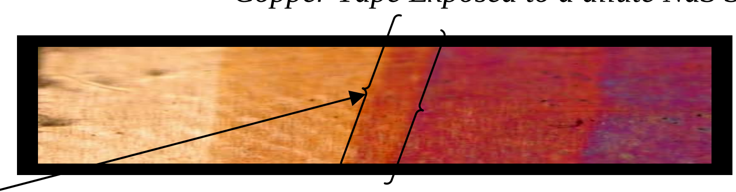
ith Minimum at $D= \lambda(2i+1)/4n$ …. Where

D = Film thickness, λ=wavelength, n= Refractive index of the thin film; i = 0 for the 1st order minimums, i = 1 for the 2nd order minimums, and so on.

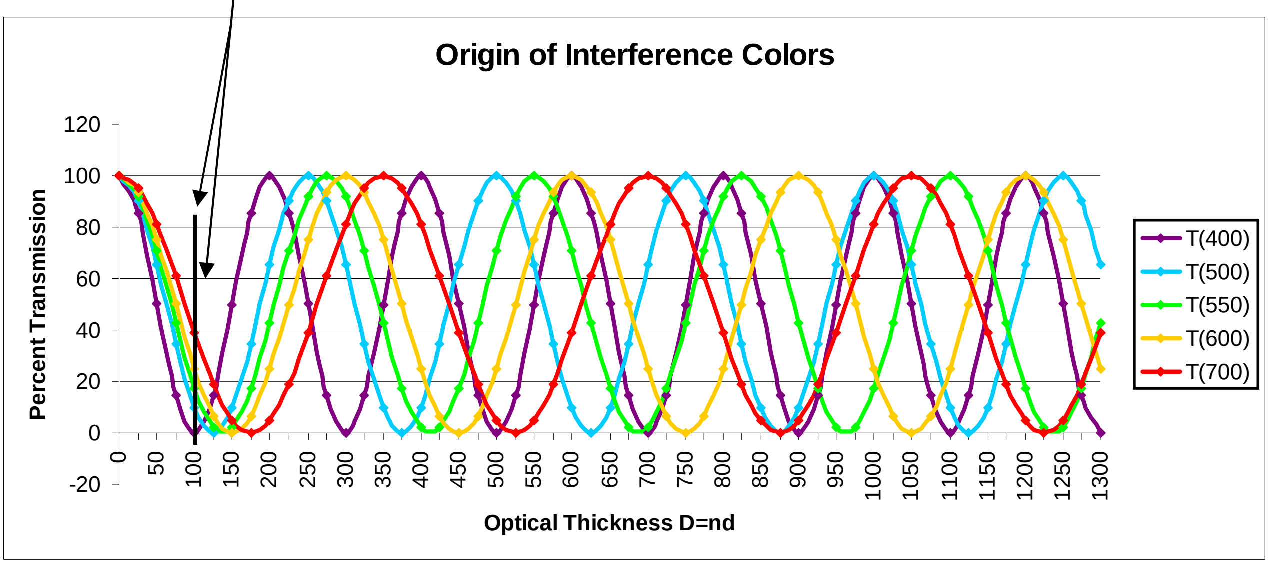
If i = 0 then the 1st green minimum (λ=550 nanometers) results in the first order red color (see Chart Below). The film thickness, D, is 53 nanometers.

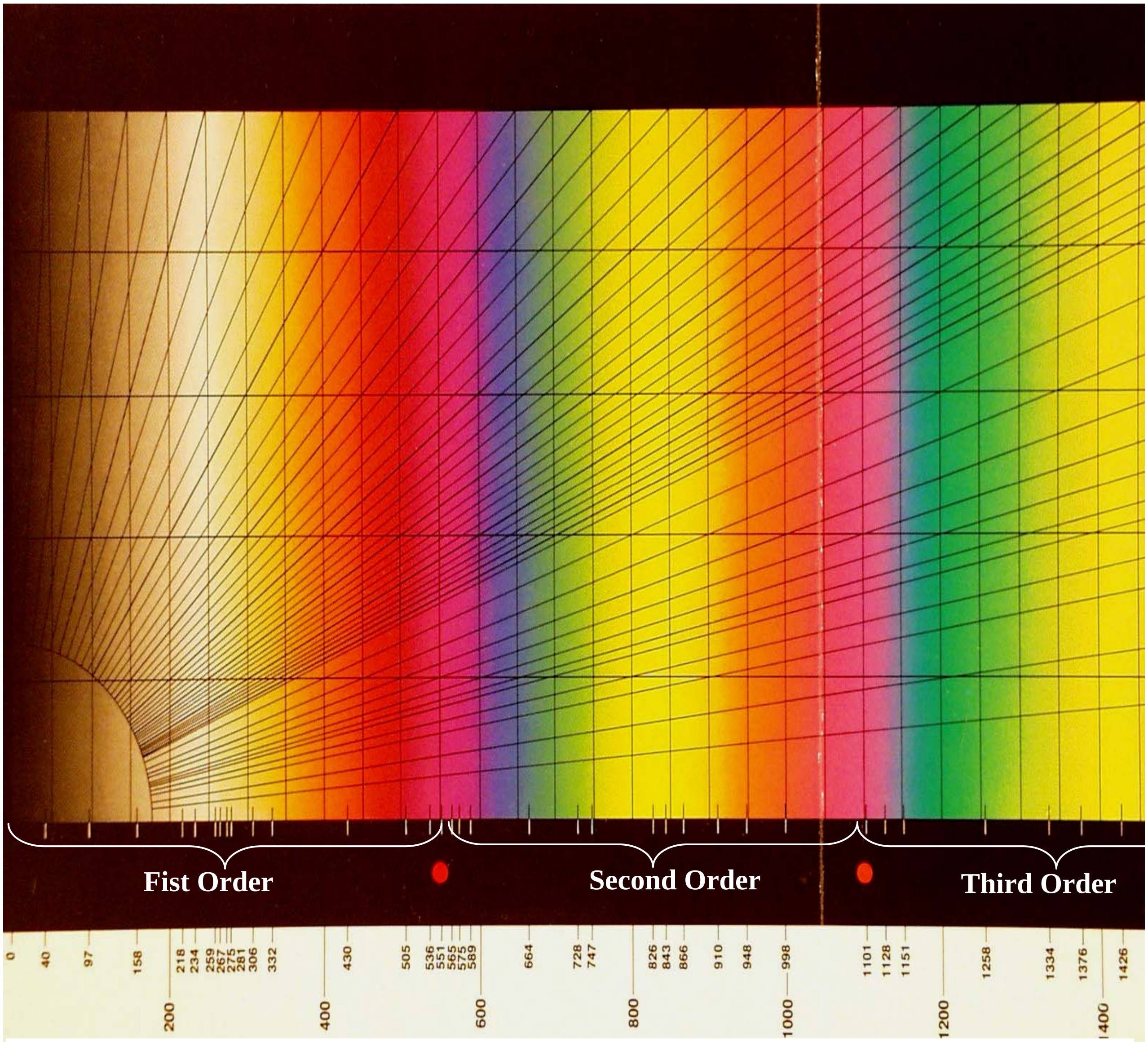


Copper Tape Exposed to a dilute NaS Solution

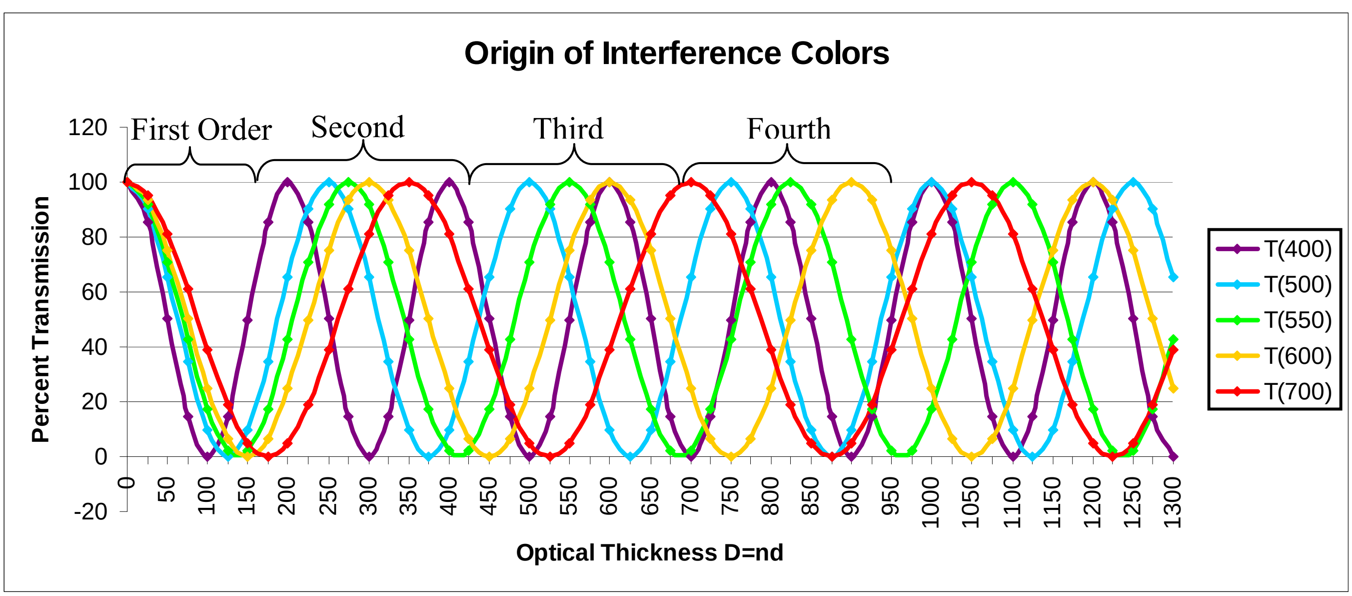


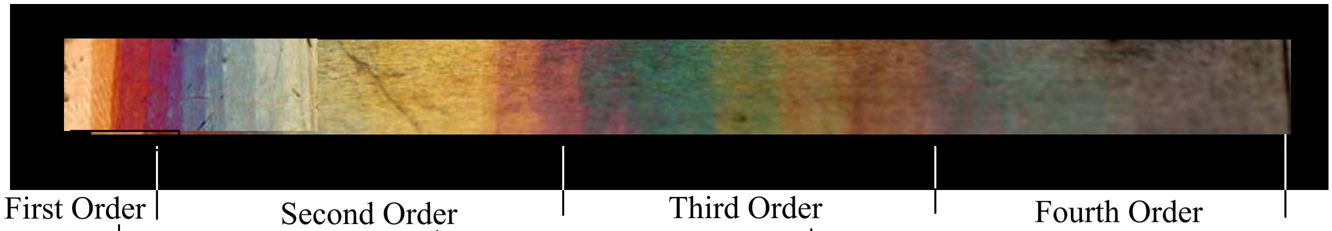
All the other wavelengths are dropping out while red is still very high in its cycle. The result is First Order Red.





The Michel-Levy chart is a good reference the when dealing with thin films. The numbers in the first order are the wavelengths of the light that disappears. In the second order, divide the numbers by 2 and in the third order divide by 3 and in each case that is the wavelength that disappears.





These are the CuS and CuO interference films. They are divided into their different orders below. The orders go from very vibrant to muted smudges of color. It is important to recognize the saturation and hue so that you can relate any given piece to a specific order. You then will be able to determine the thickness of film.