Reflected/Transmitted Nomarsky DIC Lighting

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What could be better than reflected or transmitted Nomarski differential interference contrast? Why. combining the best features of both and for very little cost. My intended use of the technique was for Nomarski reflection DIC microscopy. It will work, of course, with other types of reflection microscopy.

What this embarrassingly simple artifice accomplishes is to *simultaneously* add transmission capabilities to reflection observations with the result being improved viewing of delicate details. And, yes, because of the reflective front surface layer, the observer can study details on the bottom side of the specimen which is usually hidden from view. This requires focusing *through* the specimen and below the point of normal focus. Usually we take pains to avoid this bonus!

The procedure is as follows:

1) Place one drop of immersion oil on the aluminized front surface of a small, front surface mirror (e.g., Edmund Scientific p/n 30286).
2) Carefully place a clean glass cover slip on the oil drop.
3) Place a drop of the liquid containing specimens on the cover slip from step 2.
4) Carefully place a clean glass cover slip on top of the drop with the specimens.
5) Arrange the *optical sandwich* on the microscope stage and adjust the reflection optics as usual.

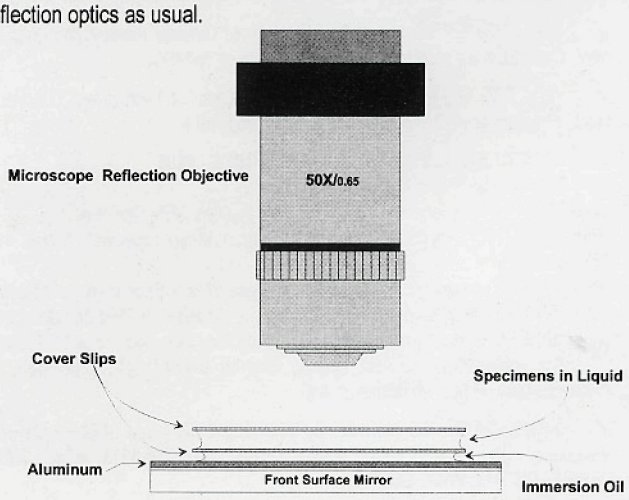

Figure 1: REFLECTION/TRANSMISSION TECHNIQUE

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The cover slip resting on the oil drop performs the following functions:

1) Protects the aluminum layer from liquids containing the specimens.
2) Serves as a shim to keep the specimens far enough from the aluminum layer to prevent mirror reflections from showing up in the field of view. This works because of the limited depth of field of typical microscope objectives.

The method will work with previously produced microscope slides which have specimens embedded in standard mounting media. The microscope slide is placed directly on the oil droplet resting on the front surface mirror, eliminating the need for the two cover slips and specimens. However, my experience indicates it is not quite as good as the cover slip technique. Also, reflection objectives are usually not corrected for cover slips. Use #0 thickness cover glasses and avoid very high power objectives.

Instead of using ready-made front surface mirrors, you can vacuum coat a reflective aluminum layer on microslides or cover slips. The combined lighting method is synergistic. I find that the results are superior to either reflected or transmitted DIC. Images are very bright and crisp. Try the technique while viewing various microorganisms. Witnessing ameboid movement across a slide with the special lighting is an experience. You will wonder how you ever got along without it! ■

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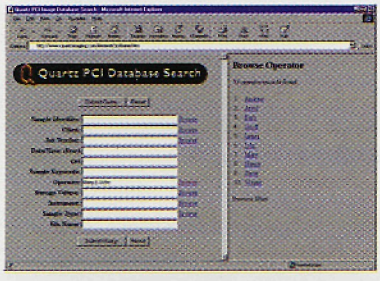

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Fe^{2+}/ Fe^{3+} Calculation In Spinels From Oxygen Deficiency Sum

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A typical electron microprobe printout of an oxide analysis shows weight percent concentrations of different elements in terms of their oxides. Fe is usually expressed as FeO. For minerals, it also shows calculated number of cations on the basis of an assumed (theoretical) number of oxygen atoms. For example,in olivines, $(Mg,Fe)_2SiO_4$, the theoretical number of oxygen atoms is four and the sum of cations should add up to three if the analysis is good. However, in case of spinels such as magnetite, Fe_3O_4, which contain significant amounts of Fe_2O_3, the analysis total falls below 100 and the cation sum (based on four oxygens) exceeds the theoretical cation sum. In other words, the formula calculation shows an oxygen deficiency. Geologists use this information to calculate the amount of Fe_2O_3 in the spinel assuming the other cations have only one oxidation state. Following is one way of doing this calculation:

$$\Sigma O = \frac{\Sigma Cat_{THEOR}}{\Sigma Cat} .(2Si + 2Ti + 1.5Al + 1.5Cr + Fe^* + Mn + Mg + Ca + Ni)$$

$$If\ \Sigma O_{THEOR} > \Sigma O,$$

$$Fe^{3+} = 2(\Sigma O_{THEOR} - \Sigma O);\ Fe^{2+} = Fe^*.\ \frac{\Sigma Cat_{THEOR}}{\Sigma Cat} - Fe^{3+};$$

$$FeO(wt\%) = FeO^*.\ \frac{Fe^{2+}}{Fe^{2+} + Fe^{3+}}\ ;\ Fe_2O_3(wt\%) = FeO^*.\ \frac{M_{Fe_2O_3}}{2M_{FeO}} . \frac{Fe^{3+}}{Fe^{2+} + Fe^{3+}}\ ;$$

$$NewTotal(wt\%) = Total - FeO^* + FeO + Fe_2O_3;$$

$$New\ \Sigma Cat = \Sigma Cat - Fe^* + Fe^{2+} + Fe^{3+}$$

$$New\ \Sigma O = \frac{\Sigma Cat_{THEOR}}{New\ \Sigma Cat} .(2Si+2Ti+1.5Al+.5Cr+1.5Fe^{3+}+Fe^{2+}+Mn+Mg+Ca+Ni)$$

where,

ΣCat and ΣO are calculated sum of cations based on a theoretical sum of oxygen, ΣO_{THEOR}; and the calculated sum of oxygen based on a theoretical sum of cations, ΣCat_{THEOR} respectively;

Si, Ti, Al, Cr, Mn, Mg, Ca and *Ni* are the calculated numbers of these cations based on ΣO_{THEOR}; Fe^* is the calculated total number of Fe atoms based on ΣO_{THEOR};

Fe^{2+} and Fe^{3+} and calculated number of divalent and trivalent Fe atoms;

FeO^* is measured wt% concentration of total Fe expressed as FeO; FeO and Fe_2O_3 are calculated wt% concentrations of FeO and Fe_2O_3 respectively;

M_{FeO} and $M_{Fe_2O_3}$ are molecular weights of FeO and Fe_2O_3 respectively;

Total and *New Total* are the oxide wt% totals before and after the Fe^{2+}/Fe^{3+} calculation;

and,
NewΣCat and *New*ΣO are the calculated sum of cations and oxygen after the Fe^{2+}/Fe^{3+} calculation.