Liquid Crystals (this is taken from "Liquid Crystals" by Kasagi, Moffat and Hirata, a section in the Handbook of Flow Visualization)

"Liquid crystals were first discovered in 1888 by the Austrian botanist, Friedrich Reinitzer. They are presently extensively used for electronic display devices. In the last twenty years, they have been used for visualization of surface temperatures", as you will do in your lab. "Liquid crystals have the following advantages:

1. they are easily handled and are inexpensive
2. they have a small and predictable effect on the flow and thermal field when proper care is taken
3. measurement is nearly instantaneous
4. they offer satisfactory accuracy and resolution

An organic compound is usually optically nonisotropic in its crystallized, solid phase but optically isotropic in the liquid phase at a temperature higher than its melting point. A particular group of organic compounds, however, exhibit behavior midway between that of an isotropic liquid and a nonisotropic crystalline solid; these compounds are generally termed 'liquid crystals' or 'mesophases.' The special term of thermotropic liquid crystal denotes a compound that displays a nonisotropic liquid character at a temperature between its pure crystalline and isotropic liquid states. Liquid crystals are in different groups. The one which is used most frequently is the cholesteric liquid crystals. This group has a peculiar helical molecular orientation in which the pitch of the helix depends on certain physical and chemical conditions. Cholesteric liquid crystals consist of very thin molecular micro-layers (approximately, 3 angstroms in thickness); the long axis of the molecules is parallel to the plane of the layers, and the direction of the molecular axis in adjacent layers appears to rotate as one moves in the direction normal to the layers. This angular displacement, which averages about 15 minutes of arc per layer, is present in each successive layer so that the overall displacement traces out a helical path. These layers have a peculiar optical characteristics. When ordinary white light is directed at these substances, the light's electric vector is separated into clockwise and counterclockwise rotating components. Depending on the material, one component is transmitted and the other is reflected. This property gives the cholesteric phase its characteristic color changes when illuminated by white light. The characteristic wavelength, which a given cholesteric liquid crystal scatters, generally depends upon the compound ingredients in the liquid crystal, temperature, imposed electric and magnetic fields, pressure, shear stress, chemical vapors in the environment, light angles of incidence and reflection, and other factors which can change the pitch of the molecular micro-layers. Cholesteric liquid crystals usually reflect long wavelengths (red) at lower temperatures and short wavelengths (blue) at higher temperatures."
FIGURE 1. Molecular arrangements of liquid crystals: (a); smectic, (b); nematic, (c); cholesteric. [10,11].