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**Observing Refractive Index (RI) in Fibers Lab**

The halo effect seen around certain substances under a microscope is called a Becke Line. When wet-mounted or immersed in a fluid a substance a fiber (in this lab) will show its refractive index. When the Becke Line is observed on the inside of the fiber’s image, the fiber has a lower refractive index than the fluid it is immersed (or “mounted”) in.

When the Becke Line is observed on the outside of the fiber’s surface, the fiber has a higher refractive index than the fluid. When the Becke Line is not seen, the fiber and the fluid have a similar refractive index. The refractive indexes of various fibers and fluids are known, as shown in the table below. This physical property can be used to identify an unknown fiber found at a crime scene, and also to match the fiber to one found elsewhere—this light property is used widely in forensic laboratories.

Refractive Index is also used in the identification of other substances like glass, soil, and hair, and many labs have equipment that performs the comparison automatically without the use of a technician and microscope.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Fiber** |  |  | **Density g/cc** | |  |  | **Refractive Index (RI)** |  |  |
|  |  |  |  |  |  |  |
|  | Cotton |  | 1.45 | | – 1.6 |  | 1.53 | |  |  |
|  | Fiberglass |  | 2.56 | |  |  | 1.54 | |  |  |
|  | Wool |  | 1.28 | | – 1.35 |  | 1.54 | |  |  |
|  | Acetate |  | 1.28 | | – 1.35 |  | 1.54 | |  |  |
|  | Nylon |  |  | 1.1 – 1.2 | |  |  | 1.53 – 1.54 |  |  |
|  | Silk |  | 1.20 | | – 1.28 |  | 1.54 | |  |  |
|  | Polyester |  | 1.35 | | – 1.45 |  |  | 1.57 – 1.60 |  |  |
|  | Acetate |  | 1.28 | | – 1.45 |  | 1.47 | |  |  |
|  | Rayon |  | 1.45 | | – 1.60 |  |  | 1.52 – 1.54 |  |  |
|  | Olefin |  | 0.90 | | – 0.95 |  |  | 1.50 – 1.54 |  |  |
|  | Acrylic (Orlon) |  |  | 1.1 – 1.2 | |  | 1.51 | |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Fluid** |  |  | **Refractive Index (RI)** |  |  |
|  |  |  |  |  |
|  | N-butyl alcohol |  | 1.402 | |  |  |
|  | Olive oil (or glycerin) |  | 1.467 | |  |  |
|  | Water |  | 1.33 | |  |  |
|  | Castor Oil |  | 1.482 | |  |  |
|  | Clove Oil |  | 1.543 | |  |  |
|  | Bromoform |  | 1.597 | |  |  |

**Materials:**

* Fiber samples of known composition
* Glass slides
* Fiber samples of unknown composition
* Cover slips
* Refractive index fluids (listed above)
* Compound microscope
* Small beakers for fluids
* Small scissors
* Eyedropper (disposable is okay)
* Tweezers

**Instructions:**

1. Place a 1cm long length of a known fiber on a microscope slide.
2. Prepare a wet-mount of the fiber by placing one drop of a liquid with a refractive index matching the fiber’s refractive index (see the chart above).
3. View the sample with a compound microscope at an appropriate magnification. You may have to pull a few filaments from the fiber so that they are more transparent (remember, that refraction only occurs if the light waves can pass through the medium).
4. If the refractive index matches exactly, the Becke Line disappears.
5. Remove the fiber with tweezers and replace it with a different fiber sample, one that has a different RI than the fluid. Note the Becke Line.
6. Repeat this several times making various wet-mounts with different fiber samples and different RI fluids.
7. Draw what you have observed with several fiber samples—label the Becke Line on each drawing. Also note on each drawing whether the RI was higher or lower than the fiber and what the possible RI of each fiber sample was.
8. Using the above chart, try to identify not only the RI of one of the unknown sample types, but also what the type of fiber is, based on its RI.