Exploring Materials—
Polarizers

How can clear tape make rainbow colors?

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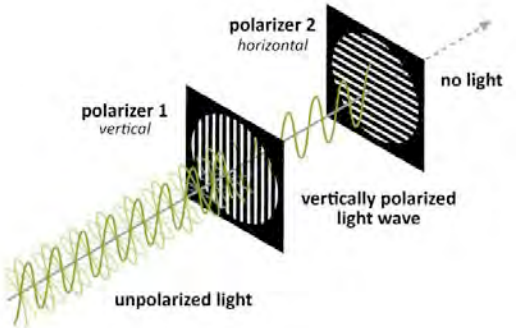
Try this!

1. Use strips of transparent tape to make designs on a clear plastic sheet. Put down lots of overlapping pieces of tape!
2. Place your design between two polarizing filters and hold everything up to a diffuse light source—a window during daylight or an overhead light.
3. Try rotating one of the filters. What happens to your design?

What's going on?

Polarizing filters block light. The light they block depends on the polarizer's orientation. When two polarizers are rotated the same way, most of the light gets through. When they're rotated 90 degrees to each other, the filters block all the light waves, and are known as "crossed polarizers."

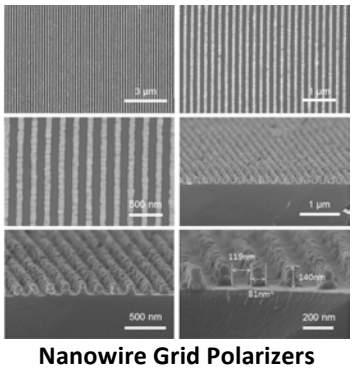
Certain materials like mica, Plexiglas®, corn syrup, and transparent tape exhibit beautiful colors when placed between two crossed polarizers. These materials produce colors because they are *birefringent*. In birefringent materials, light passes through the material at different speeds.



Polarizers only allow certain orientations of light waves to get through

The transparent tape interacts with polarized light in a special way because of the structure of the tape. The tape consists of long polymer molecules that are stretched along the length of the tape. As a result, light moves through the tape at different speeds, depending on whether it's oriented parallel or perpendicular to these long polymer molecules. Once the light makes it through the tape, the light components that were moving quickly recombine with the ones that were moving more slowly, producing waves with new properties. The second polarizing filter blocks most of these waves, which filters the white light and produces the different colors we see. The color of the tape is determined by the direction the light moves and the thickness of the tape. So we can produce different colors by placing the tape at different angles or by stacking pieces of tape on top of each other.

How is this nano?



Nanowire Grid Polarizers (NWGPs)

The way a material behaves on the macroscale is affected by its structure on the nanoscale. Researchers are studying ways to make polarizers out of aligned metal nanowires. The nanowires they use are less than 100 nm wide, much too small for us to see with our eyes! In these nanowire grid polarizers (NWGPs), light that is oriented parallel to the NWGP interacts with the metal wires and is reflected from the surface. However, light perpendicular to the wires transmits through.

NWGPs show a lot of promise and have many advantages over more conventional polarizers. For example, NWGPs are more compact and have wide viewing angles, making excellent polarizers. However, like many new technologies, there are still manufacturing and performance challenges that engineers must solve before these polarizers can become widely used.