CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

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Project Number

J1312

Project Title

Investigating the Properties of Iridescence and Structural Color

Abstract

Objectives/Goals

Iridescence occurs in many natural objects that have "thin film", which create effects of shimmering color not through the use of pigment, but through refraction of light in the thin molecular layers at the object's surface. This phenomenon is called "structural color". Although they produce a similar iridescence, there are significant differences in the structure of the natural thin films and artificial diffraction surfaces. I wanted to explore the different properties of thin films and artificial diffractions, regarding the surface of the object, and the angle of reflection.

Methods/Materials

I performed multiple tests on a variety of iridescent objects. I tested iridescent minerals such as feathers, shells and insects. I used a rotating apparatus to measure the angle at which the iridescence is visible and at what angle the color of the object changes. I also tested several diffraction gratings by reflecting the laser off the surface of the grating. I measured the distance between the dots that were projected by the diffraction grating, following the grating equation (m)lambda=Dsin(theta), I was able to calculate the number of ridges or grooves on the diffraction grating, as well as establish that the angle of reflection was related to the incident wavelength and the grating spacing.

Results

There was a significant difference in the way that iridescence is viewed between the natural and artificial thin film. Artificial objects change color approximately every three degrees. Iridescence is visible no matter what the angle of light is. Natural thin films have a range at which the iridescence can be viewed.

Conclusions/Discussion

I was also able to calculate the number of ridges in a diffraction grating using the grating equation: M(lambda)=Dsin(theta). The number of ridges came to an average of two thousand eight hundred ridges per centimeter. I was unable to use the laser to test the natural thin films, because the structure of the thin film is so complex that the light waves bounce in random directions, forming a speckled pattern of interference.

Summary Statement

I tested the difference between artificial diffractions and thin film refractions, regarding the angle of iridescence and the way light interacts with the geometric surface.

Help Received

I used lab equipment at the University of California San Diego under the supervision of Dr. Radic.