Determining Plastics through the Use of a Grating Spectrometer

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The intent of this project is to determine if a diffraction grating spectrometer is able to detect the differences between resin types of plastics. Determining plastic-type is important because the plastic resins need to be sorted by type or they will become trash and not be recycled. I believe that the diffraction grating spectrometer will be able to determine the differences between different plastics such as polypropylene and polyethylene. I tested this hypothesis by building a diffraction grating spectrometer and measuring the different household plastics using an oscilloscope and a vidicon. I ran five different trials of four varieties of plastic; polypropylene, polystyrene, polyethylene, and polyethylene terephthalate. I collected the data from the oscilloscope connected to the output of a vidicon detector. I analyzed the transmittance using Principal Components Analysis (PCA) to determine if the spectrum could be used to distinguish the samples. The results from PCA identified the minimum number of wavelengths necessary to classify the samples.To enable a more practical spectrometer, I built a grating spectrometer based upon a simple halogen flashlight bulb and a germanium photodiode. Using the results from the PCA, I was able to reduce the number of data points collected from 100,000 using the vidicon to 20 using the germanium detector. With the new experiment I ran five trials for each of the four types of plastic and using PCA, this new, more cost-effective spectrometer could also differentiate between the types of plastic. In conclusion, my hypothesis was correct in that the spectrometer can identify the differences between different varieties of plastics and classify them into their five different resin types.

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