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BE 492 Section B5a

February 4, 2019

Lab 1: Spectroscopy I

**Part B:**



Figure B1: The side skim-milk spectrum blue shifted compared to the water and forward skim milk

Transmitted light is red shifted due the longer path scattering shorter wavelength light. the scattered or side path with the milk is noticeably blue shifted as shorter wavelength light scatters more. The particles within the milk interact more to similar sized shorter wavelengths. Red light, or longer wavelength, tend to interact less, thus the spectrum of the long/forward path through milk is red shifted.

The averages for each spectrum are as follows: 683 nm for water, 662 nm for the side skim milk and 743 nm for the skim milk long path.

%BE 492 Part B

partBsideskimilk = importdata('PartB\_side\_skimilk.txt');

partBskimilk = importdata('PartB\_skimilk.txt');

partBwatertabdelim = importdata('PartB\_water\_tabdelim.txt');

%importing backgrounds, unused due to shiftcorrect error below

%partBsidebackground = importdata('PartB\_side\_background.txt');

%partBskimilkbackground = importdata('PartB\_skimilk\_background.txt');

%partBwaterbackground = importdata('PartB\_water\_background.txt');

%shiftcorrect = partBskimilk(:,2) - partBskimilkbackground(:,2);

%this provides negative numbers, does not make sense to delete background

%as such

a2 = plot(partBskimilk(:,1),partBskimilk(:,2), 'Linewidth', 1, 'Marker', '+', 'MarkerIndices', 1:10:2048);

%alternative plot method dependent on import method (using matlab tool or

%import read)

%a1 = plot(PartBsideskimilk.VarName1, PartBsideskimilk.VarName2, 'Linewidth', 2, 'Marker', '+', 'MarkerIndices', 1:10:2048);

hold on

a1 = plot(partBsideskimilk(:,1),partBsideskimilk(:,2),'Linewidth', 3, 'LineStyle', '-.');

%a2 = plot(PartBskimilk.VarName1, PartBskimilk.VarName2, 'Linewidth', 3, 'LineStyle', '-.');

hold on

%a3 = plot(PartBwatertabdelim.VarName1, PartBwatertabdelim.VarName2,'Linewidth', 2, 'LineStyle', '- -');

a3 = plot(partBwatertabdelim(:,1),partBwatertabdelim(:,2), 'Linewidth', 2, 'LineStyle', '- -');

legend([a1, a2, a3], ["Side Skim Milk", "Skim Milk", "Water"]);

xlabel('Wavelength nm');

ylabel('Intensity');

axis([335 1050 0 3600]);

%To calculate average

%create a weight by multiplying each column then dividing by absorbance

skimilkavg = sum(partBskimilk(:,2).\*partBskimilk(:,1))/sum(partBskimilk(:,2));

sideskimilkavg = sum(partBsideskimilk(:,2).\*partBsideskimilk(:,1))/sum(partBsideskimilk(:,2));

wateravg = sum(partBwatertabdelim(:,2).\*partBwatertabdelim(:,1))/sum(partBwatertabdelim(:,2));

**Part C:**

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Figure C1: Spectra for water, Phenol Red short and long.

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Figure C2: µa(λ) \* L for Phenol Red long and short pathlengths.

The peak for the long pathlength is at 598 nm and for the short pathlength is 592nm. These wavelengths correspond to yellow. This does not necessarily describe why it had a red appearance, but given this and that phenol red in basic form is red it means that the solution used in lab was basic. Phenol red is yellow when acidic. The ratio of the heights is 1.62 which is close to the ratio of the long side to the short side of the cuvette (11.7/5.8 = 2.02).

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Figure C3: µa(λ) \* L for Phenol Red with the addition of 1, 2 and 3 µL vinegar.

The largest peaks were just at the 600 nm mark, however with the addition of vinegar a peak begins to form at just about 460nm. The isosbestic point seems to occur at 485nm.

%BE 492 Part C

partCphenolred = importdata('PartC\_phenolRed.txt');

partCphenolredrotated = importdata('PartC\_phenolRed\_rotated.txt');

partCphenolred1ul = importdata('PartC\_phenolRed\_1ulVinegar.txt');

partCphenolred2ul = importdata('PartC\_phenolRed\_2ulVinegar.txt');

partCphenolred3ul = importdata('PartC\_phenolRed\_3ulVinegar.txt');

partCwater = importdata('PartC\_water.txt');

a2 = plot(partCphenolredrotated(:,1),partCphenolredrotated(:,2), 'Linewidth', 1, 'Marker', '+', 'MarkerIndices', 1:10:2048);

hold on

a1 = plot(partCphenolred(:,1),partCphenolred(:,2),'Linewidth', 3, 'LineStyle', '-.');

hold on

a3 = plot(partCwater(:,1),partCwater(:,2), 'Linewidth', 2, 'LineStyle', '- -');

hold on

legend([a1, a2, a3], ["Long", "Short", "Water"]);

xlabel('Wavelength nm');

ylabel('Intensity');

axis([335 1050 0 3600]);

hold off

%for mu\_a(L) graphs

%add small offset to water spectra; divide phenol red spectra by offset water spectra; take natural log

wateroffset = partCwater(:,2) + 0.01;

figure2 = figure('Name', 'Phenol Red Short and Long');

phenolredplot=-log(partCphenolred(:,2)./wateroffset);

phenolredrotatedplot=-log(partCphenolredrotated(:,2)./wateroffset);

b1 = plot(partCphenolred(:,1), phenolredplot);

hold on

b2 = plot(partCphenolred(:,1), phenolredrotatedplot);

hold off

xlabel('Wavelength nm');

legend([b1 b2], ["Long Path", "Short Path"]);

figure3=figure('Name', 'Phenol Red and Vinegar');

phenolred1ulplot = -log(partCphenolred1ul(:,2)./wateroffset);

c1 = plot(partCphenolred(:,1), phenolred1ulplot);

hold on

phenolred1u2plot = -log(partCphenolred2ul(:,2)./wateroffset);

c2 = plot(partCphenolred(:,1), phenolred1u2plot);

hold on

phenolred1u3plot = -log(partCphenolred3ul(:,2)./wateroffset);

c3 = plot(partCphenolred(:,1), phenolred1u3plot);

hold on

xlabel('Wavelength nm');

legend([c1 c2 c3], ["1uL", "2uL", "3uL"]);

**Part D:**



Figure D1: Zoomed in view of finger with, without rubber band and differing integration times.



Figure D2: Full view

|  |  |  |
| --- | --- | --- |
| **Wavelength** | **900ms Integration Time** | **450ms Integration Time** |
| **660nm** | 1.65 | 2.92 |
| **850nm** | 0.865 | 2.14 |

Table D1: Oxy/Deoxy ratios for normal vs tight and varying integration times. Calculated by manually tracing the spectra values at 660nm and 850nm.

The reason for the same integration time oxy/deoxy ratio being with one ratio being lower than one and greater than one is that the amount of light being scattered decreases, but the amount of ballistic light increases.

%BE 492 Part D

partDnormal = importdata('PartD\_normal.txt');

partDtight450ms = importdata('PartD\_tight\_450ms.txt');

partDtight900ms = importdata('PartD\_tight\_900ms.txt');

a2 = plot(partDtight450ms(:,1),partDtight450ms(:,2), 'Linewidth', 1, 'Marker', '+', 'MarkerIndices', 1:10:2048);

hold on

a1 = plot(partDnormal(:,1),partDnormal(:,2),'Linewidth', 3, 'LineStyle', '-.');

hold on

a3 = plot(partBwatertabdelim(:,1),partBwatertabdelim(:,2), 'Linewidth', 2, 'LineStyle', '- -');

legend([a1, a2, a3], ["Normal", "Rubber Band 450 ms", "Rubber Band 900ms"]);

xlabel('Wavelength nm');

ylabel('Intensity');

axis([335 1050 0 3600]);