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## Lab #2 Electron Diffraction Data Analysis

close all, clear all, clc;

## Original Data, in imperical units and conversion to metric

along with determination of mean heights and standard error

ring\_height\_in=[0.839 1.576 0.945 1.662 0.966 1.780 1.023 1.944 1.181 2.064

 0.856 1.559 0.909 1.651 0.976 1.753 1.044 1.960 1.133 2.022

 0.882 1.580 0.922 1.681 0.946 1.778 1.059 1.963 1.173 2.021

 0.895 1.575 0.928 1.652 0.942 1.784 1.063 1.976 1.127 2.031

 0.898 1.586 0.960 1.655 0.973 1.736 1.024 1.941 1.156 2.051

 0.859 1.595 0.913 1.659 0.984 1.748 1.021 1.938 1.128 2.061

 0.863 1.572 0.891 1.664 0.988 1.759 1.022 1.956 1.161 2.054

 0.886 1.582 0.915 1.662 0.942 1.781 1.039 1.941 1.131 2.064

 0.884 1.580 0.922 1.661 0.981 1.755 1.052 1.936 1.121 2.072

 0.871 1.599 0.914 1.662 0.939 1.766 1.026 1.947 1.101 2.003 ];

ring\_height\_m=ring\_height\_in.\*0.0254;

mean\_ring\_height=mean(ring\_height\_m)

SE\_ring\_height=std(ring\_height\_m)./sqrt(length(ring\_height\_m(:,1)))

mean\_ring\_height =

 Columns 1 through 9

 0.0222 0.0401 0.0234 0.0422 0.0245 0.0448 0.0263 0.0495 0.0290

 Column 10

 0.0519

SE\_ring\_height =

 1.0e-003 \*

 Columns 1 through 9

 0.1520 0.0916 0.1546 0.0674 0.1563 0.1315 0.1313 0.1046 0.2035

 Column 10

 0.1871

## Calculation of extrapolated height for a flat surface tangent to center

of the diffraction tube

h0=mean\_ring\_height./2; *% I used 1/2 the height so that the geometry of the*

*% triangles is a simpler calculation for only one side*

h=.1315\*tan((1/2).\*asin(15.15151515.\*h0))

error\_h=.002\*tan((1/2).\*asin(15.15151515.\*h0)); *%I am using the error in*

*%the length of the manufacturing of the tube for this calculation because*

*%the Standard Error of the measurements is negligible relative to the*

*%manufacturing error of plus/minus 2mm*

D=2\*h *% Converting back to the entire form*

error\_D=2\*error\_h;

VA=[5000,5000,4500,4500,4000,4000,3500,3500,3000,3000];

root\_VA=sqrt(VA);

hold on

errorbar(root\_VA(1:2:end),D(1:2:end),error\_D(1:2:end))

errorbar(root\_VA(2:2:end),D(2:2:end),error\_D(2:2:end),'g')

title('Ring Diameter vs. Square Root of Anode Voltage');

xlabel('sqrt(V)'), ylabel('D (meters)');

legend('Inner Ring','Outer Ring');

hold off

L=.13; h\_bar=1.055e-34; c=2.998e8; e=1.602e-19; m=9.109e-31;

h =

 Columns 1 through 9

 0.0111 0.0205 0.0118 0.0216 0.0123 0.0230 0.0133 0.0256 0.0146

 Column 10

 0.0270

D =

 Columns 1 through 9

 0.0223 0.0410 0.0235 0.0432 0.0246 0.0460 0.0265 0.0512 0.0292

 Column 10

 0.0539



## Calculation of the lattice spacing in the graphite along with the error

in the calculation of the spacing

d\_inner=(4\*pi\*L\*h\_bar\*c)./(D(1:2:end).\*sqrt(2\*e\*VA(1:2:end)\*m\*c^2));

d\_outer=(4\*pi\*L\*h\_bar\*c)./(D(2:2:end).\*sqrt(2\*e\*VA(2:2:end)\*m\*c^2));

lattice\_spacing=[mean(d\_outer),mean(d\_inner)] *%I have it in this order because*

*% the data shows that d\_outer is greater than d\_inner*

*% once again I am using the error in the constuction of the tube because it*

*% is of a minimum order 10^10 greater than the standard error of the mean*

L\_error=.002;

d\_error=((4\*pi\*(L+L\_error)\*h\_bar\*c)./((D-error\_D).\*sqrt(2\*e\*VA\*m\*c^2))-...

 (4\*pi\*(L-L\_error)\*h\_bar\*c)./((D+error\_D).\*sqrt(2\*e\*VA\*m\*c^2)))/2;

d\_in\_error=mean(d\_error(1:2:end));

d\_out\_error=mean(d\_error(2:2:end));

lattice\_error=[d\_out\_error,d\_in\_error]

*% finding the percent error of the lattice spacing against known values*

Actual\_spacing=[.123,.213]\*1e-9;

percent\_error=(Actual\_spacing-lattice\_spacing)./Actual\_spacing\*100

*% percent error of closest values within error of calculations*

lattice\_close=lattice\_spacing+lattice\_error

close\_percent\_error=(Actual\_spacing-lattice\_close)./Actual\_spacing\*100

lattice\_spacing =

 1.0e-009 \*

 0.1087 0.2025

lattice\_error =

 1.0e-011 \*

 0.3325 0.6198

percent\_error =

 11.6526 4.9152

lattice\_close =

 1.0e-009 \*

 0.1120 0.2087

close\_percent\_error =

 8.9491 2.0055