

Analysis of Semiconductor Layer Thicknesses Using an SEM

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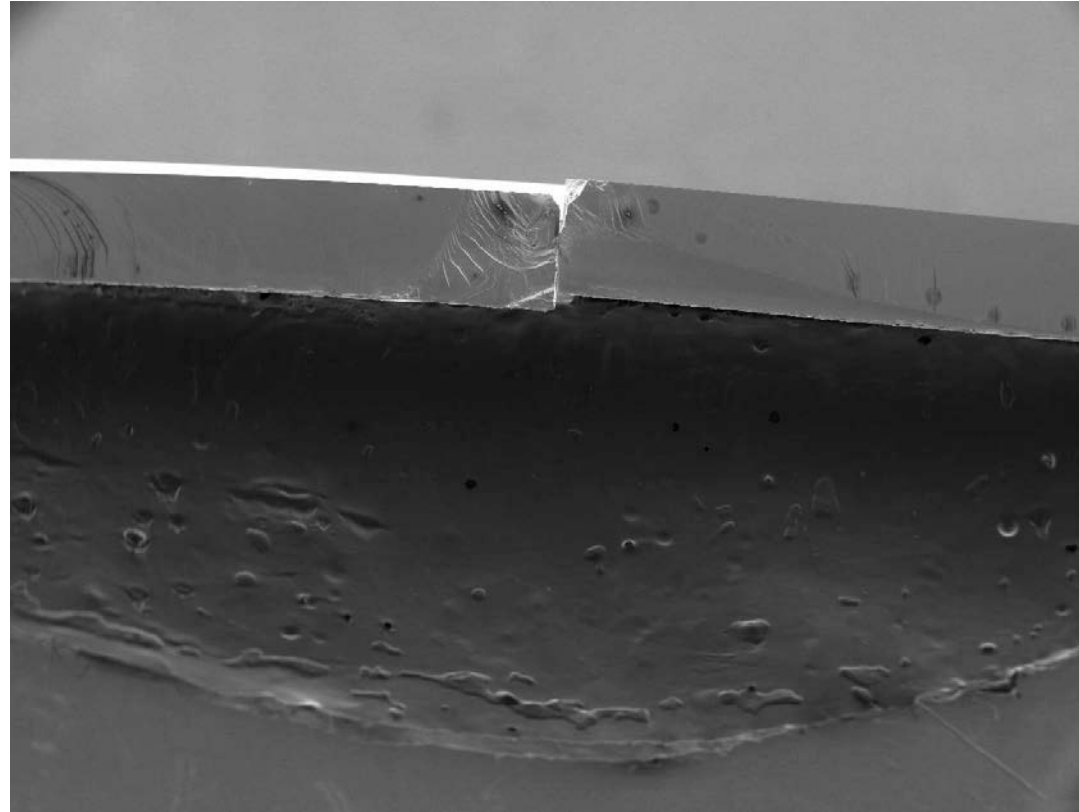
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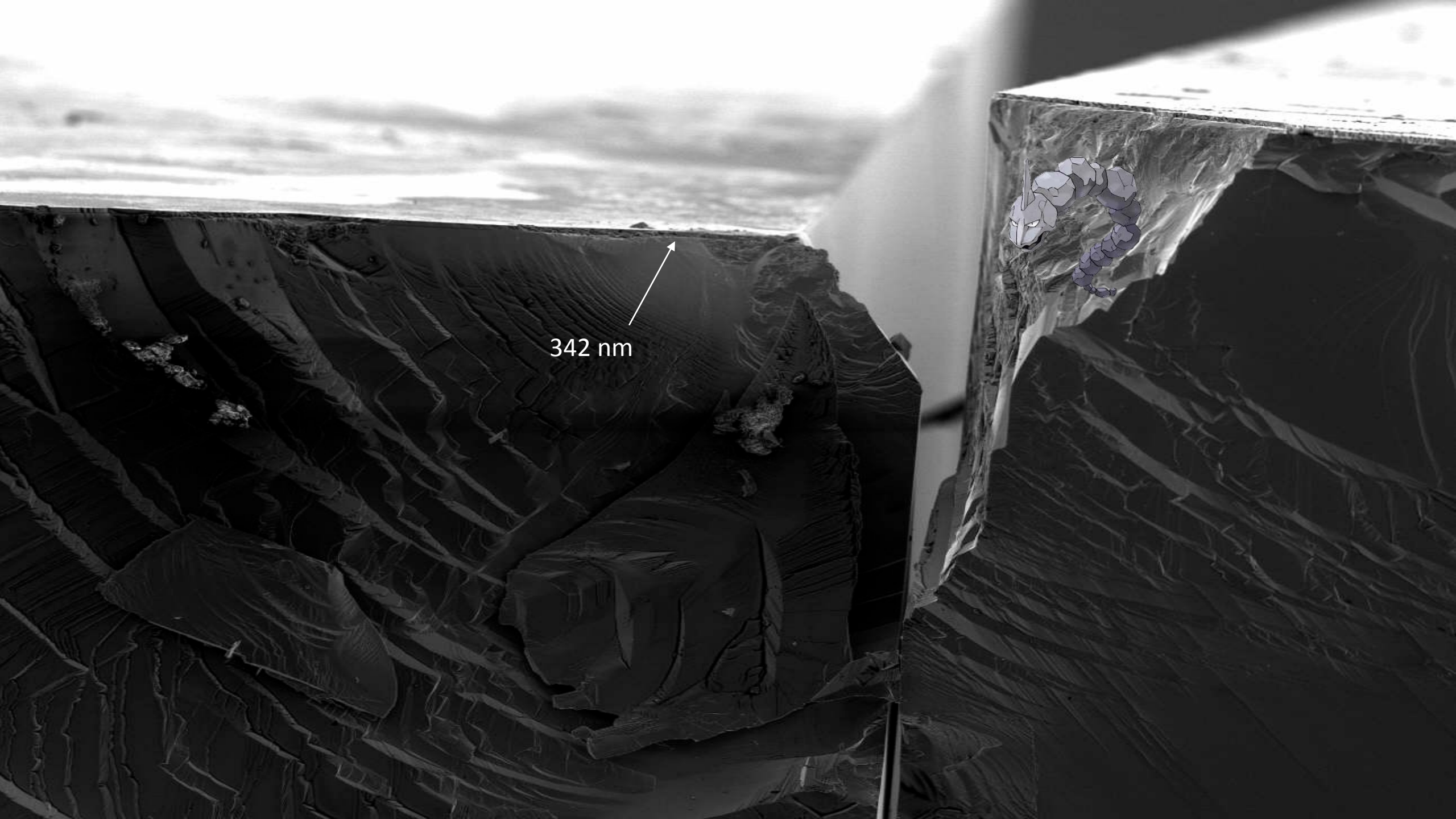
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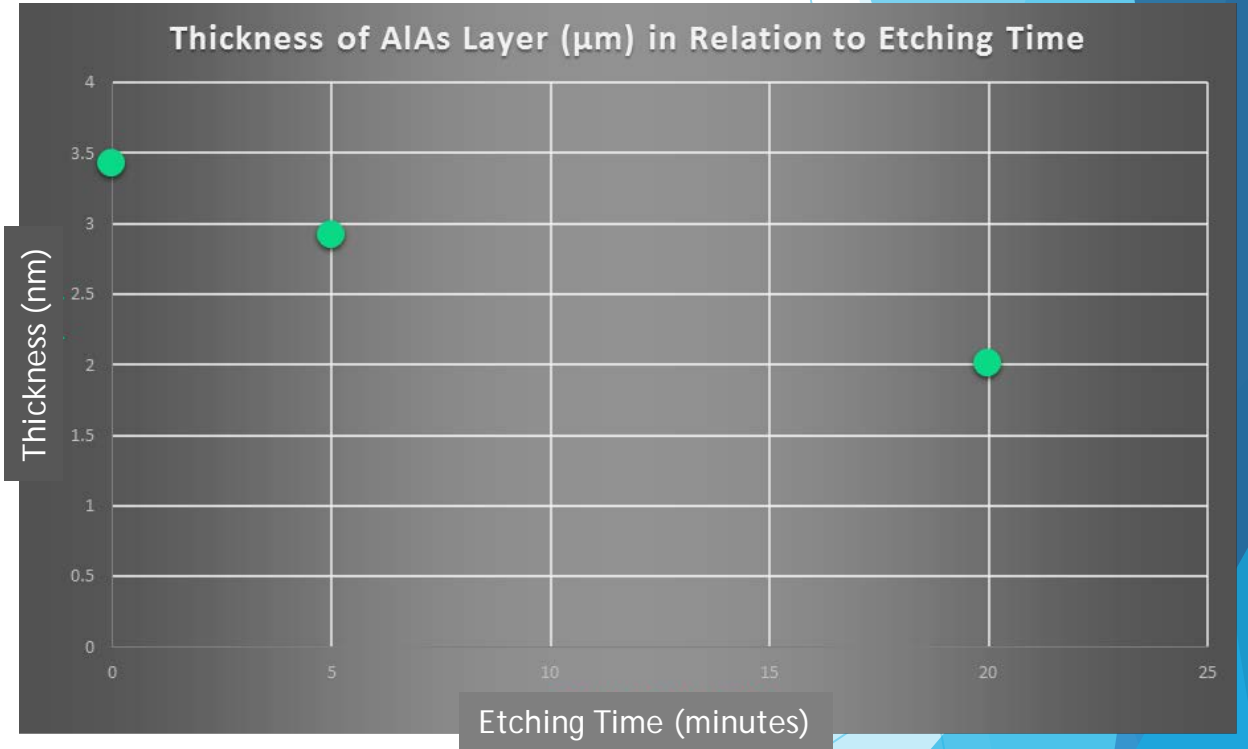
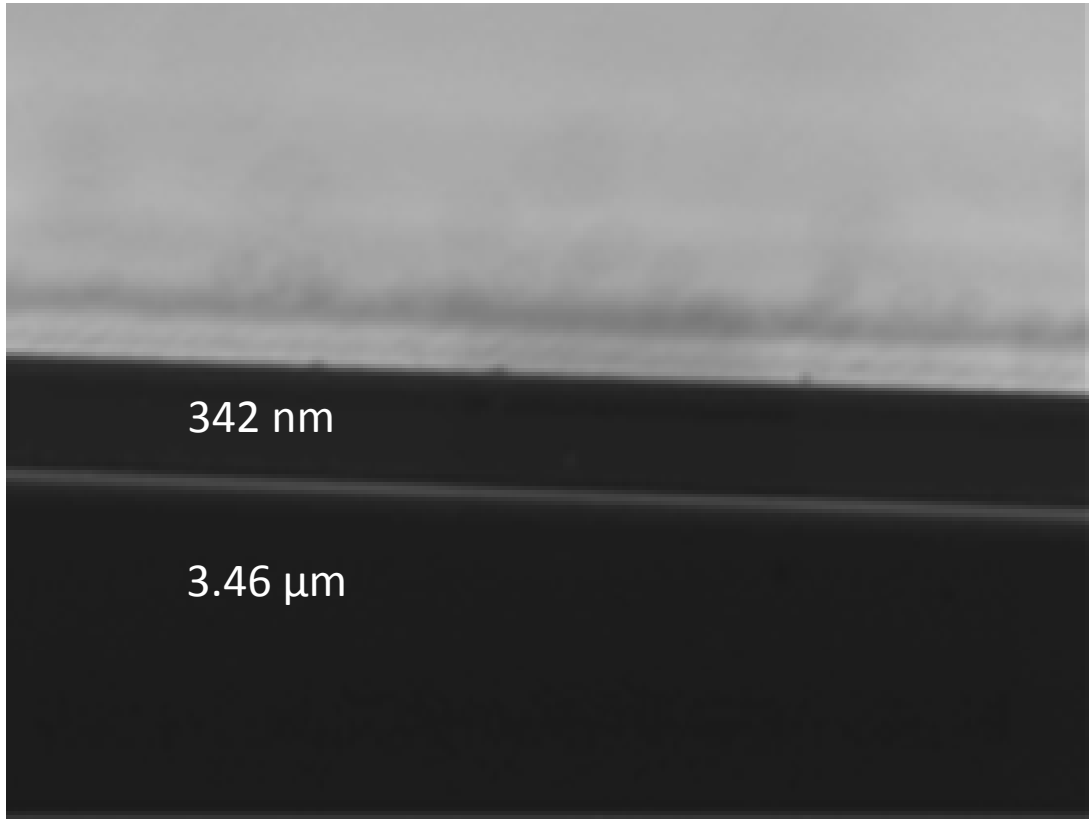
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- Aluminum Arsenide oxidized to Aluminum Oxide
- Several samples
- All samples examined at a 90 degree angle to measure thickness from the side





342 nm



```

1   % initial prompt, asks user which method will be used
2   initial_prompt = ['Welcome. Would you like to calculate thickness at \n' ...
3       'a single point or a range of thicknesses? Enter 1 for point, 2 for range, \n' ...
4       '3 for further explanation, 4 to quit: \n'];
5   calc_type = input(initial_prompt);
6
7   % main if/else statement that takes user to desired calculation
8
9   if calc_type == 1 % point calculation
10      %prompt for desired thickness
11      prompt1 = 'Enter the desired end thickness point: ';
12      end_thickness = input(prompt1);
13      % equation below
14      original_thickness = end_thickness + 1;
15      if original_thickness > 0
16          display(original_thickness)
17      else
18          display('ERROR: Input yields negative result, enter different number.')
19      end
20
21  elseif calc_type == 2 % range calculation
22      %prompt for range
23      prompt2 = ['Enter a range in this format - [x:y:z] - If you do not \n' ...
24          'know what the variables mean, enter 1 (WARNING: May yield \n' ...
25          'negative results): '];
26      end_thickness = input(prompt2);
27      if end_thickness == 1 % if user wants help, goes here
28          display('X is the starting number, Y is how much you wish to ')
29          display('increment by, and Z is the ending number. For example, ')
30          display('entering [4:2:10] will return an array that starts at 4,')
31          display('ends at 10, and counts up by 2.')
32          return;
33      %equation below
34      else
35          original_thickness = end_thickness + 1
36      end
37
38  elseif calc_type == 3 % explanation - may be removed
39      display('explanation coming soon')
40      return;
41
42  elseif calc_type == 4 % program exit
43      display('Exiting the program.')
44      return;
45
46  else % error message if other number is entered
47      display('ERROR: Invalid number')
48      return;
49
50  end
51

```



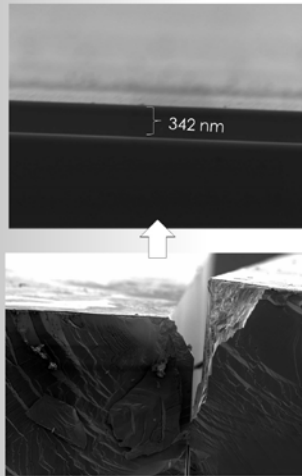
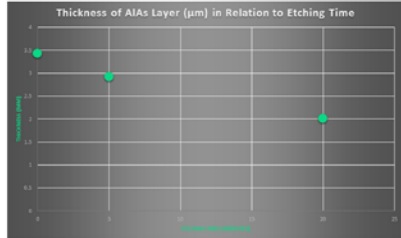
Analysis of AIAs Layers Before and After Oxidation Via SEM



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Nonlinear optical processes have various important roles in photonic applications. However, since bulk media does not display strong nonlinearities, the nonlinearities must be enhanced by using optical resonators known as microcavities to confine light for longer periods of time. Through a unique technique proposed by Z. Lin et al. [1], these microcavities consist of Aluminum Arsenide (AIAs) layers that can be oxidized to create Aluminum Arsenide (AIAs) and Gallium Arsenide (GaAs) layers on a Gallium Arsenide wafer (GaAs).

- Purpose: determine the effect of oxidation on the AIAs layer and manipulate the data in order to determine a best-fit function showing the relationship between etching time and thickness
- From the data, the function was determined to be $y = 0.002x^2 - 0.1098x + 3.42$, Where x = etching time and y = thickness
- Additionally, the R² value equaled 1, signaling that the equation is a perfect fit for the data



```

1 % Initial prompt, asks user which method will be used
2
3 initial_prompt = 'Please enter the range of thicknesses in µm: '
4
5 % Ask user for a range of thicknesses: Enter 1 for range, 2 for single, 3 for
6
7 % For the user's selection, it will be used to
8
9 main_type = input(initial_prompt)
10
11 % Main if/else statement that asks user to choose resolution
12
13 if main_type == 1 % 1 point resolution
14     % Prompt for resolution
15     prompt1 = 'Enter the desired resolution point: '
16     res_resolution = input(prompt1)
17     % Resolution factor
18     original_thickness = res_resolution * 10
19     if original_thickness > 0
20         display(original_thickness)
21     else
22         display('Error: Input invalid! Negative number, zero, or different number.')
23     end
24
25 elseif main_type == 2 % Range resolution
26     % Prompt for range
27     prompt2 = 'Enter a range in this format - (x1,y1) - If you do not list '
28     % Prompt user to indicate when, when 2, whether they want to
29     % 'repeat resolution' '1'
30     % 'repeat resolution' '1'
31     res_resolution = input(prompt2)
32
33     if res_resolution == 1 % 1 if user wants help, user here
34         display('1' is the resolution number, 2 is the number you want to
35         display('x1,y1' and 2 is the ending number, for example, '1
36         display('repeating this will result in using that value as '1'
37         display('x1, and counts up by 1.')
38         return
39     end
40
41     % Repeat until
42     main
43     original_thickness = res_resolution * 1
44     end
45
46 elseif main_type == 3 % Replication - may be removed
47     display('replication coming soon')
48     return
49
50 elseif main_type == 4 % Program exit
51     display('Exiting the program.')
52     return
53
54 % User message if other number is entered
55 display('Error: Invalid number')
56
57 end
  
```

- A MATLAB program would prompt the user to input a post-etching thickness that he or she desired
- The input can be a single value or a range of values, returning a single value or range of values, respectively
- These single values and ranges of values that are returned are the required thicknesses prior to etching or oxidation

From the graph and equation, it can be concluded that the AIAs layer experiences shrinkage when it is oxidized. Additionally, the function and the MATLAB program were proven to be accurate because the initial thickness was calculated when the final thickness was entered into the program.

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* These authors contributed equally to this work



This work has been supported in part by MIRTHE (NSF-ERC)