



Analysis of AIAs Layers Before and After Oxidation Via SEM



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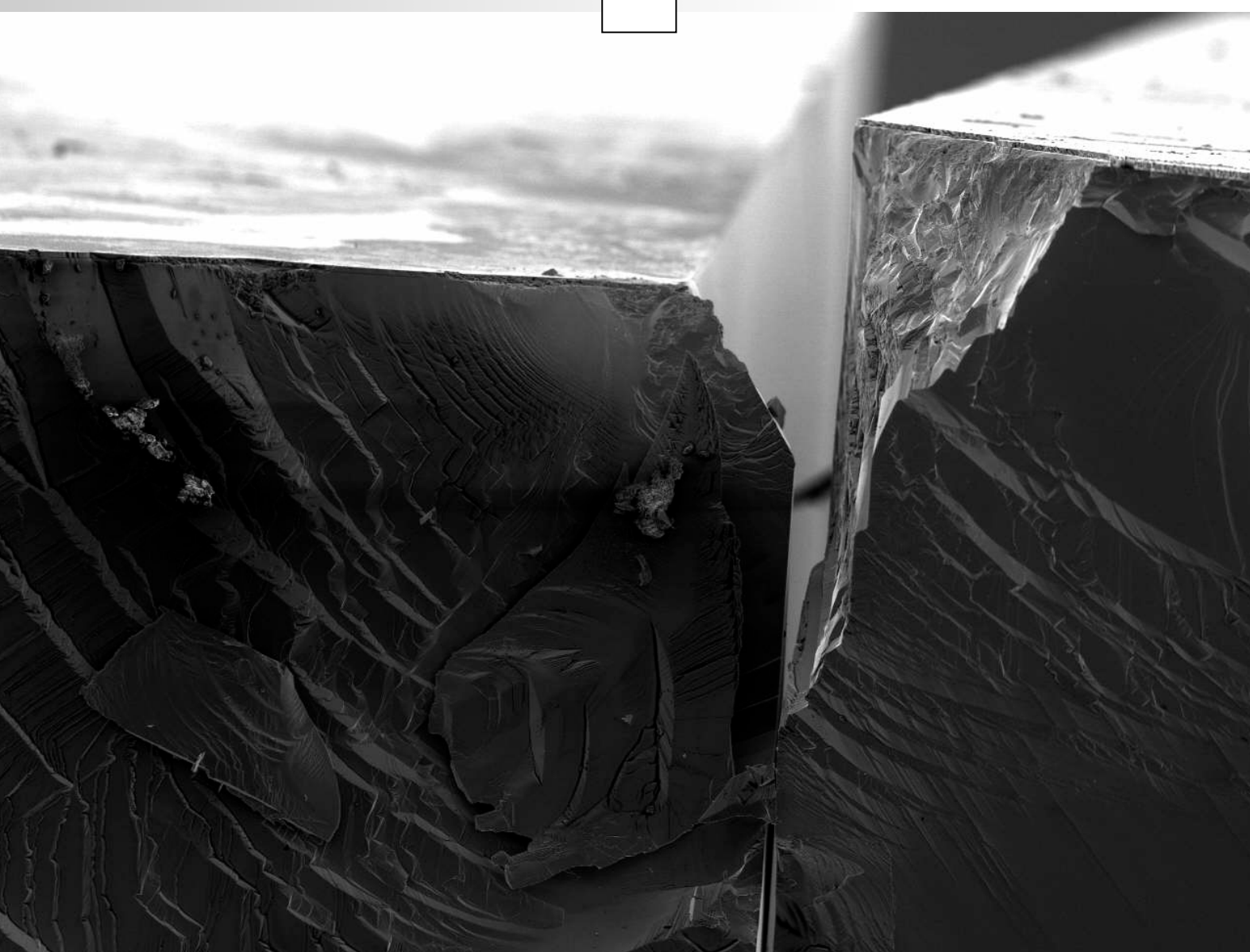
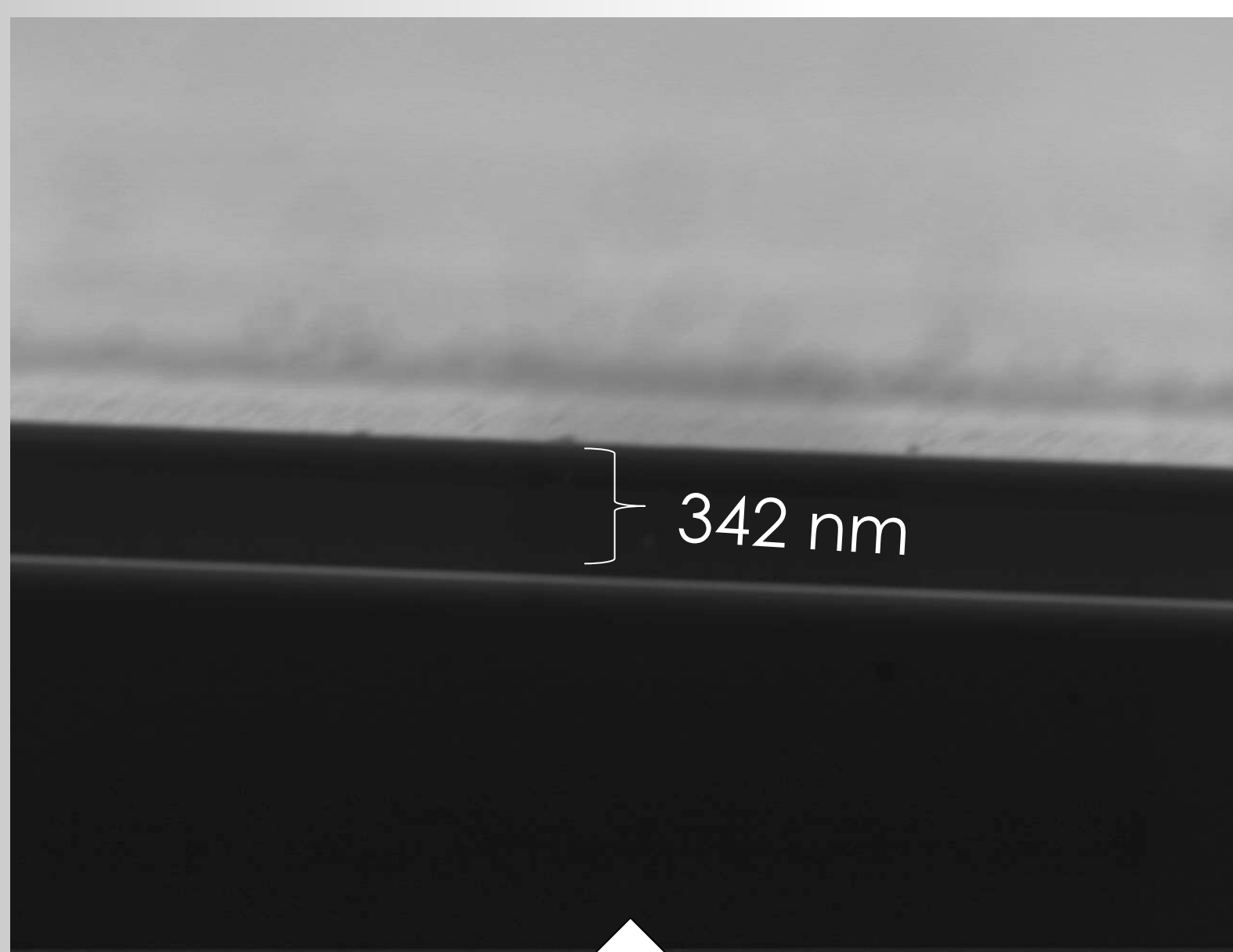
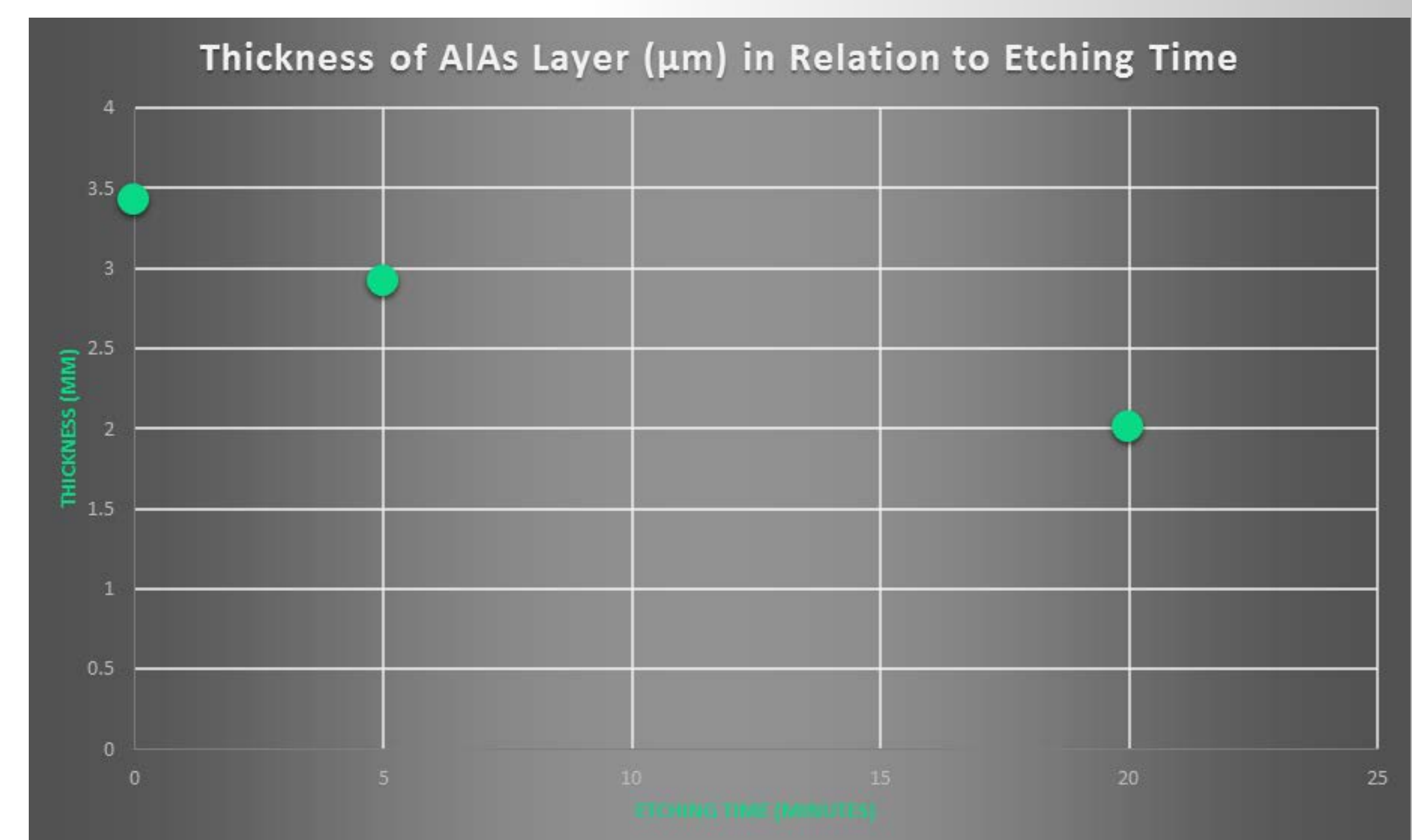
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Nonlinear optical processes have various important roles in photonic applications. However, since bulk media does not display strong nonlinearities, the nonlinearities must be enhanced by using optical resonators known as microcavities to confine light for longer periods of time. Through a unique technique proposed by Z. Lin et al., these microcavities consist of Aluminum Arsenide (AIAs) layers that can be oxidized to create Aluminum Oxide (AlO₃) 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



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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 - [x1:y2] - If you do not \n' ...
24 'know what the variables mean, enter 1 (WARNING: May yield \n' ...
25 'negative results): '];
26 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

```

- 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.

* These authors contributed equally to this work



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