1

Plan for today

- Syllabus review
- How to write a lab report
  - Sections
  - Writing for easy reading
  - Figures
  - Statistics – errors, significant figures, etc.

2

Before we begin

- Write the following on your paper
  - Your year in the MSE program
  - One thing you're interested in (in or out of school)
  - What you hope your degree will help you do in life

  - Something(s) you didn't understand about this lecture (do this at the end)

3

Course	EngrMSE 160: Advanced Laboratory in Synthesis and Characterization of Materials	
Description	Synthesis and characterization of ceramic, polymer, and electronic materials. Connect the process, structure, properties, and performance of materials science knowledge to a hands-on laboratory setting *Pre-requisites:* ENGR 54 or Chem 130 A-B or Chem 156	
Lecture	Tu/Th, 9:30 - 10:50 AM in SSTR 101	Only Tuesday
Laboratory	M/W Section: 1:00-4:50pm ET 649/637 Tu/Th Section: 1:00-4:50pm ET 649/637	Staggered bc limited lab equipment and TAs
Instructor	Professor William Bowman UCI Email: will.bowman Available by appointment	
Teaching Assistants	Hasti Vahidi, UCI email: vahidih Caroline Qian, UCI email: cyqian	
Lab Manager	Steve Weinstock UCI email: steve.weinstock	
Grading	Lab Reports (3) 50% Final Presentations 20% Pre-lab quizzes 15% Team work 10% Instructor discretion 5%	
Campus Resources	Academics Academic Honesty Policies Center for Excellence in Writing and Communication	

4

Course has 3 modules

- Polymer, ceramic, semicondutor

Lectures

- Week 1 – How to write a lab report
- Week 2 – Polymer synthesis
- Week 3 – Polymer characterization
- Week 4 – None Write lab reports
- Week 5 – Ceramic synthesis
- Week 6 – Ceramic characterization
- Week 7 – None Write lab reports
- Week 8 – Semiconductor synthesis
- Week 9 – Semiconductor characterization
- Week 10 – None Final presentations and lab reports

5

Lab Calendar

M/W Group 1 – 14 students (section 19432)
M/W Group 2 – 14 students (section 19433)
T/Th Group 1 – 7 students (half of section 19431)
T/Th Group 2 – 7 students (half of section 19431)

	Monday	Tuesday	Wednesday	Thursday
Week 1 **1/6 – 1/9**	No Lab	No Lab	No Lab	No Lab
		Lecture topic: How to write a lab report		No Lecture
Week 2 **1/13 – 1/16**	No Lab	No Lab	**QUIZ ON POLYMER LAB MANUAL** Polymers - Crosslinking - DSC - Hot-stage OM	**QUIZ ON POLYMER LAB MANUAL** Polymers - Crosslinking - DSC - Hot-stage OM
		Lecture topic: Polymer synthesis		No Lecture
Week 3 **1/20 – 1/23**	No Lab	No Lab	**QUIZ ON POLYMER LAB MANUAL** Polymers - Crosslinking - DSC - Hot-stage OM	**QUIZ ON POLYMER LAB MANUAL** Polymers - Crosslinking - DSC - Hot-stage OM
		Lecture topic: Polymer characterization		No Lecture
Week 4 **1/27 – 1/30**	Lab report writing workshop (optional)	Lab report writing workshop (optional)	**M/W Groups polymer lab reports due by 1 PM PST** No Lab	**T/Th Groups polymer lab reports due by 1 PM PST** No Lab
		No lecture		No Lecture

6

Tu/Th group 1 is last names A – L
Tu/Th group 2 is last name M – Z

Lab Calendar

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Email me if you want to switch

7

Modules 2 & 3: two lab times

Lab Calendar
M/W Group 1 – 14 students (section 19432)
M/W Group 2 – 14 students (section 19433)
T/Th Group 1 – 7 students (half of section 19431)
T/Th Group 2 – 7 students (half of section 19431)

Week 5 **2/3 – 2/6**	**QUIZ ON CERAMICS LAB MANUAL** Ceramics - Si NP synthesis - ORMOSIL synthesis	**QUIZ ON CERAMICS LAB MANUAL** Ceramics - Si NP synthesis - ORMOSIL synthesis	Ceramics characterization - DLS - XRD/SEM - FTIR	Ceramics characterization - DLS - XRD/SEM - FTIR
		Lecture topic: Ceramic synthesis		No Lecture
Week 6 **2/10 – 2/13**	**QUIZ ON CERAMICS LAB MANUAL** Ceramics - Si NP synthesis - ORMOSIL synthesis	**QUIZ ON CERAMICS LAB MANUAL** Ceramics - Si NP synthesis - ORMOSIL synthesis	Ceramics characterization - DLS - XRD/SEM - FTIR	Ceramics characterization - DLS - XRD/SEM - FTIR
		Lecture topic: Ceramic characterization		No Lecture
Week 7 **2/17 – 2/20**	Lab report writing workshop (optional)	Lab report writing workshop (optional)	**M/W Groups ceramic lab reports due by 1 PM PST** No Lab	**T/Th Groups ceramic lab reports due by 1 PM PST** **No Lab**
		No lecture		No Lecture

8

Week 9 **3/2 – 3/5**	**QUIZ ON SEMICONDUCTOR LAB MANUAL** Semiconductors - Resistivity measurements OR - Au NP synthesis	**QUIZ ON SEMICONDUCTOR LAB MANUAL** Semiconductors - Resistivity measurements OR - Au NP synthesis	Semiconductors - Resistivity measurements OR - Au NP synthesis	Semiconductors - Resistivity measurements OR - Au NP synthesis
		Lecture topic: Semiconductor characterization		No Lecture
Week 10 **3/9 – 3/12**	**M/W Group 1 final presentations**	**T/Th Groups 1 & 2 final presentations**	**M/W Group 2 final presentations**	**No Lab**
		No Lecture		No Lecture
Week 11 **3/14 – 3/20**			**M/W Groups semiconductor lab reports due by 1 PM PST**	**T/Th Groups semiconductor lab reports due by 1 PM PST**

9

Final presentations

- Details are given in syllabus
- For the "How to give a talk" presentation, just come to lecture
  - Lessons are sprinkled throughout

10

How to write a lab report

11

Effective communication is
getting the message across

Get your audience to

- pay attention to
- understand
- be able to act upon

a message

12

Effective communication is getting the message across

Get your audience to

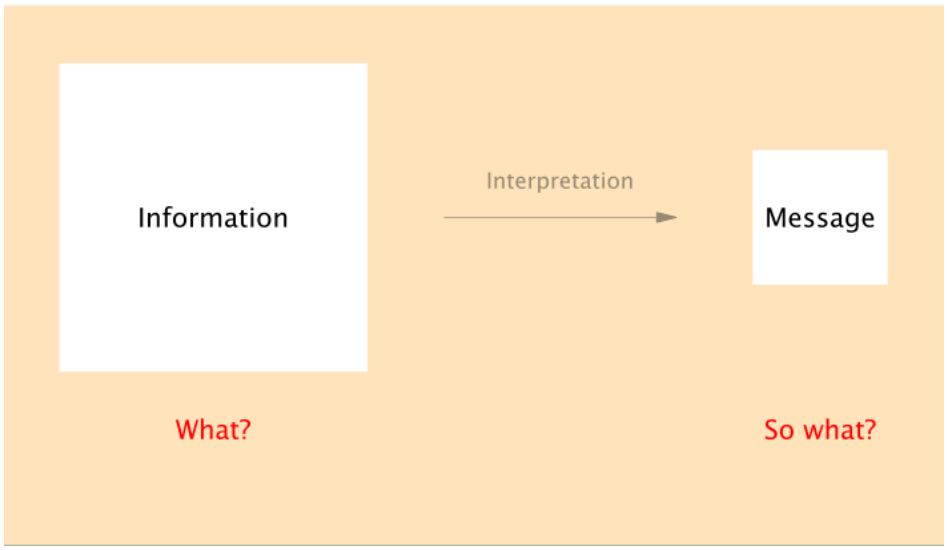
- pay attention to
- understand
- be able to act upon

a message

What action to you want the instructors to do after they read your report?

13

Effective communication is getting the message across



14

Effective communication is optimization under constraints

Get your audience to

- pay attention to
- understand
- be able to act upon

a maximum of message(s), given constraints

15

Academic writing is a poor preparation for communication in the real world

	Academia	Real world
Audience	Single, well-defined More knowledgeable Captive	Multiple, unpredictable Less knowledgeable Selective
Purpose	Demonstrate knowledge	Inform, convince, …

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Lab report sections

17

Abstract: 300 words or less, summary of each key results and significance.

Introduction: Explain relevance of project to the field.

Objective/Hypothesis: Clearly state the hypothesis of the work or the goal

Who can give an example hypothesis? A statement of what you think will happen given your prior knowledge

Perhaps you have some hypotheses about this course…

18

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Objective/Hypothesis: Clearly state the hypothesis of the work or the goal

Who can give an example hypothesis? A statement of what you think will happen given your prior knowledge

Perhaps you have some hypotheses about this course…

Hypotheses and open questions

This project tests the hypothesis that overall electronic charge transport through the polycrystalline film is facilitated by the most conductive GBs, and within this "most-conductive" subset of GBs there are similar atomic and electronic structures.

19

Materials and Experimental Methods:

Results: Graphs and tables showing results

Discussion: Interpret and explain all results including observations.

20

Conclusion: State the overall outcome(s) of the experiment and the overall significance

Works Cited: Give a full bibliography in which you acknowledge all of the references

Appendix: Include sketches, photographs, raw data

21

Lab report sections

Abstract: 300 words or less, summary of each key results and significance.

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Most documents are chronological, except for the appendices

23

What interests readers is…

Components of primary interest

Readers

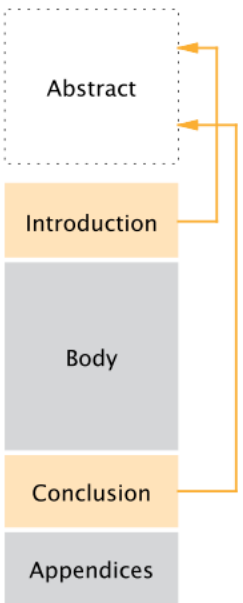
Readers

24

What interests readers is not what interests authors

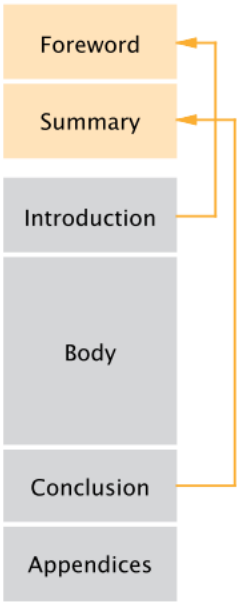
25

Put what interests readers upfront in an abstract



26

Put what interests readers upfront in an abstract



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An effective summary includes both a *foreword* and a *summary*

Foreword

The *before*

Need

(= problem)

A way to motivate the audience

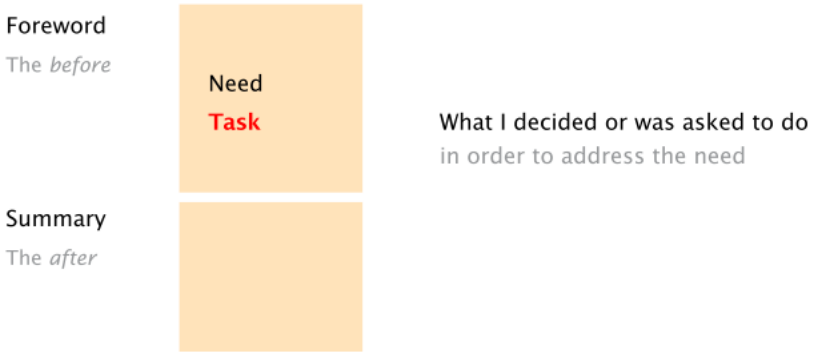
(what you have ≠ what you want)

Summary

The *after*

28

An effective summary includes both a *foreword* and a *summary*



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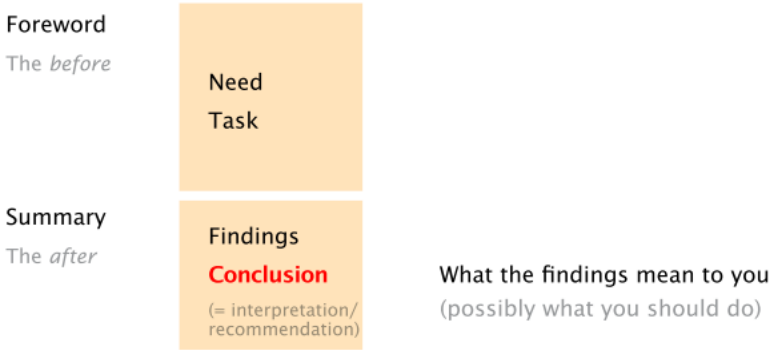
An effective summary includes both a *foreword* and a *summary*

30

An effective summary includes both a *foreword* and a *summary*



31

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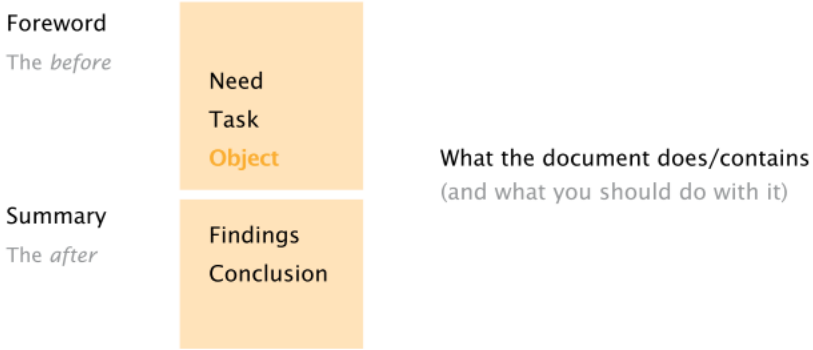

32

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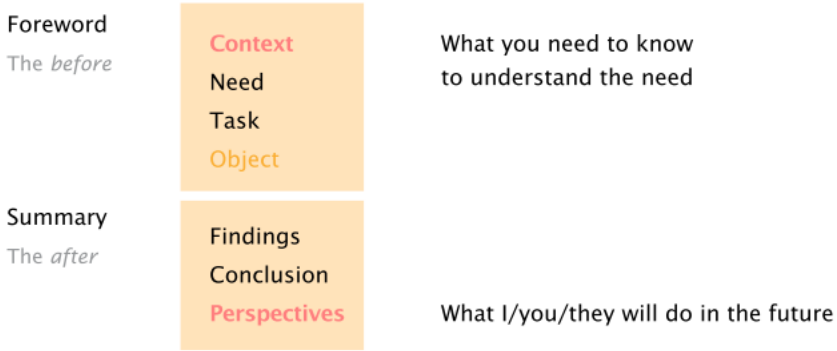
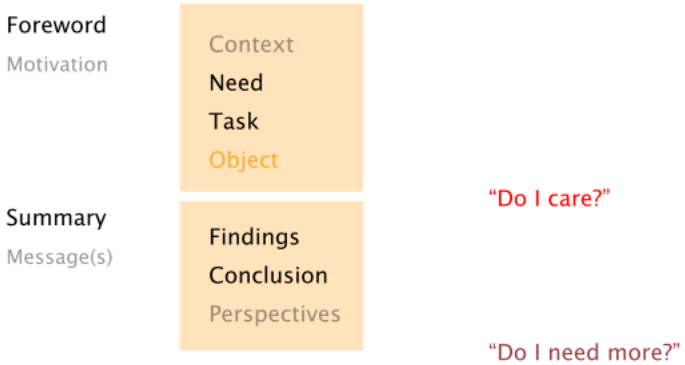


33

An effective abstract helps readers make informed decisions



34

Writing for easy reading

- "Writing to *communicate effectively*"

35

What is wrong with this abstract?

This paper describes PLTO, a link-time instrumentation and optimization tool we have developed for the Intel IA-32 architecture. A number of characteristics of this architecture complicate the task of link-time optimization. These include a large number of op-codes and addressing modes, which increases the complexity of program analysis; variable-length instructions, which complicates disassembly of machine code; a paucity of available registers, which limits the extent of some optimizations; and a reliance on using memory locations for holding values and for parameter passing, which complicates program analysis and optimization. We describe how PLTO addresses these problems and the resulting performance improvements it is able to achieve.

36

On simple RISC architectures, post-link-time optimization of executable programs delivers significant performance improvements. However, the applicability of this technique has not yet been evaluated for more complex CISC architectures such as the widely used Intel IA-32 processor family. We have developed PLTO, a link-time instrumentation and optimization tool for IA-32. This paper describes how PLTO addresses the complexities of this processor architecture and which analyses and optimizations contribute to the achieved performance improvements. Currently, PLTO achieves a moderate speedup of about 6% on average. We expect bigger speedups once we have solved a remaining problem involving significantly increased instruction cache misses.

37

Context

On simple RISC architectures, post-link-time optimization of executable programs delivers significant performance improvements. However, the applicability of this technique has not yet been evaluated for more complex CISC architectures such as the widely used Intel IA-32 processor family. We have developed PLTO, a link-time instrumentation and optimization tool for IA-32. This paper describes how PLTO addresses the complexities of this processor architecture and which analyses and optimizations contribute to the achieved performance improvements. Currently, PLTO achieves a moderate speedup of about 6% on average. We expect bigger speedups once we have solved a remaining problem involving significantly increased instruction cache misses.

38

Need

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39

Task

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40

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Object

41

On simple RISC architectures, post-link-time optimization of executable programs delivers significant performance improvements. However, the applicability of this technique has not yet been evaluated for more complex CISC architectures such as the widely used Intel IA-32 processor family. We have developed PLTO, a link-time instrumentation and optimization tool for IA-32. This paper describes how PLTO addresses the complexities of this processor architecture and which analyses and optimizations contribute to the achieved performance improvements. Currently, PLTO achieves a moderate speedup of about 6% on average. We expect bigger speedups once we have solved a remaining problem involving significantly increased instruction cache misses.

Findings

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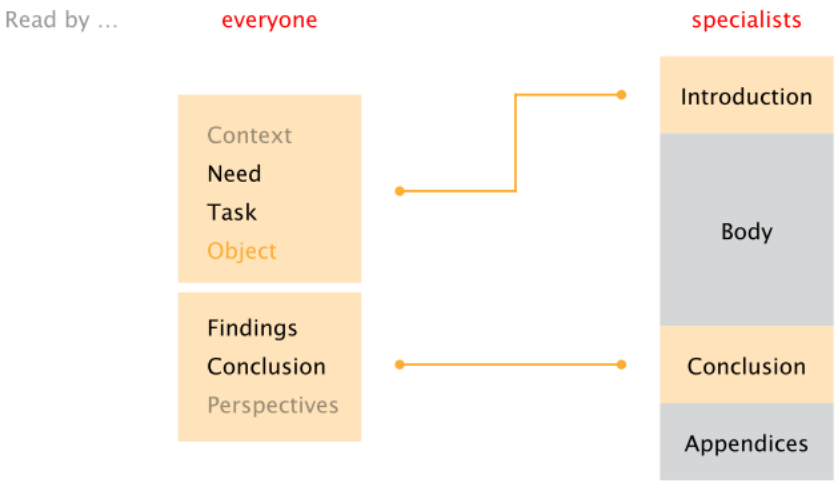
Conclusion
Perspect.

On simple RISC architectures, post-link-time optimization of executable programs delivers significant performance improvements. However, the applicability of this technique has not yet been evaluated for more complex CISC architectures such as the widely used Intel IA-32 processor family. We have developed PLTO, a link-time instrumentation and optimization tool for IA-32. This paper describes how PLTO addresses the complexities of this processor architecture and which analyses and optimizations contribute to the achieved performance improvements. Currently, PLTO achieves a moderate speedup of about 6% on average. We expect bigger speedups once we have solved a remaining problem involving significantly increased instruction cache misses.

What about the other sections?

Abstract *versus* full document: much more than copy/paste

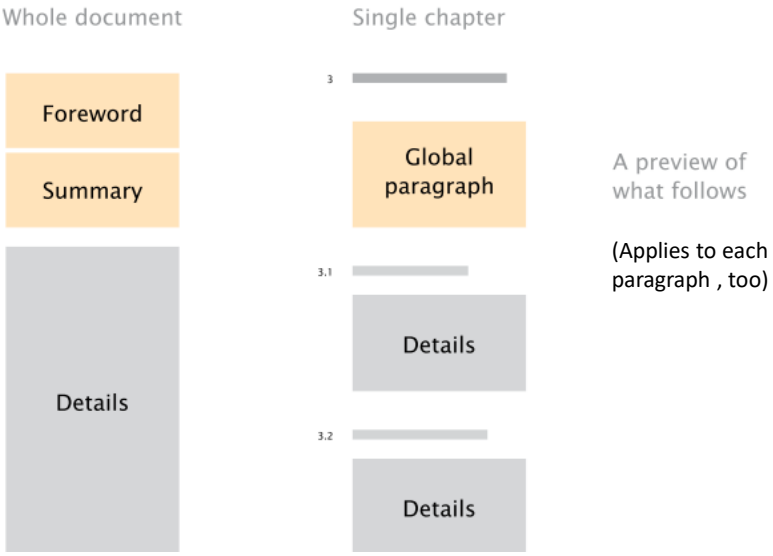


45

First tell the beginning and the end, then the rest—whether short or long

46

Prepare the reader for what follows



47

An example paragraph

Single-use, disposable medical devices are pre-packaged and sterilized by the manufacturer. The packaging is chosen to provide protection for the product, to facilitate sterilization, to maintain sterility, and to be easy to use. Reusable devices, by contrast, must be durable both in service and in their ability to withstand repeated sterilization. …

48

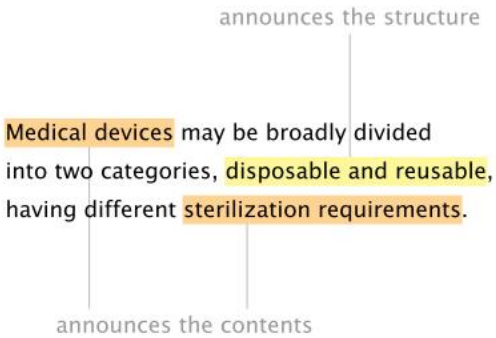
Single-use, disposable medical devices are pre-packaged and sterilized by the manufacturer. The packaging is chosen to provide protection for the product, to facilitate sterilization, to maintain sterility, and to be easy to use. Reusable devices, **by contrast**, must be durable both in service and in their ability to withstand repeated sterilization. ...

49

Medical devices may be broadly divided into two categories, disposable and reusable, having different sterilization requirements. Single-use, disposable medical devices are pre-packaged and sterilized by the manufacturer. The packaging is chosen to provide protection for the product, to facilitate sterilization, to maintain sterility, and to be easy to use. Reusable devices, by contrast, must be durable both in service and in their ability to withstand repeated sterilization. ...

50

Prepare the readers for content and structure, with a topic sentence



51

Similar strategy for discussing figures

Figure 2 shows the evolution of the germanium content in the SiGe layer. Obviously there is a nearly linear decrease of the germanium content with increasing fluence, apart from a near constant region around 2×10^{17} at/cm^2. Knowing the number of atoms that has been sputtered and the O_2 fluence, it is then quite easy to calculate the germanium sputter yield.

52

To be kept Ineffectively redundant

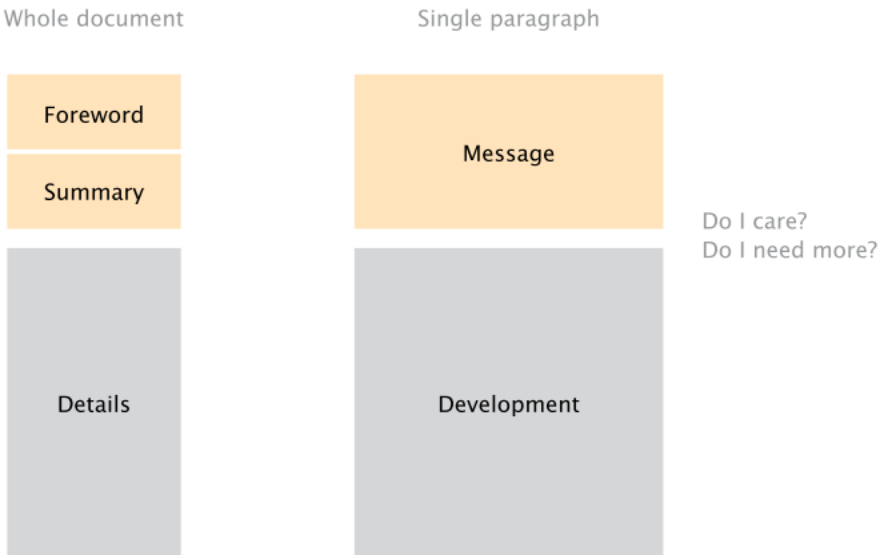
Figure 2 ~~shows the evolution of the germanium content in the SiGe layer. Obviously~~ there is a nearly linear decrease of the germanium content with increasing fluence, apart from a near constant region around 2×10^{17} at/cm^2. Knowing the number of atoms that has been sputtered and the O_2 fluence, it is then quite easy to calculate the germanium sputter yield.

53

The germanium content decreases linearly with increasing fluence apart from a near constant region around 2×10^{17} at/cm^2 (Figure 2). Knowing the number of atoms that has been sputtered and the O_2 fluence, it is then quite easy to calculate the germanium sputter yield.

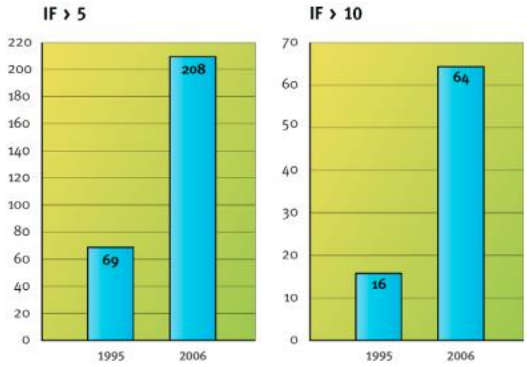
54

Again, state your message upfront



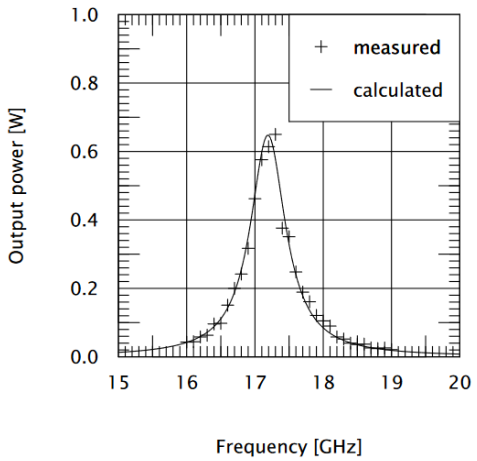
A few words about figures

Nonverbal aspects, such as graphs, are up for improvement, too



What in this figure is unnecessary?

57

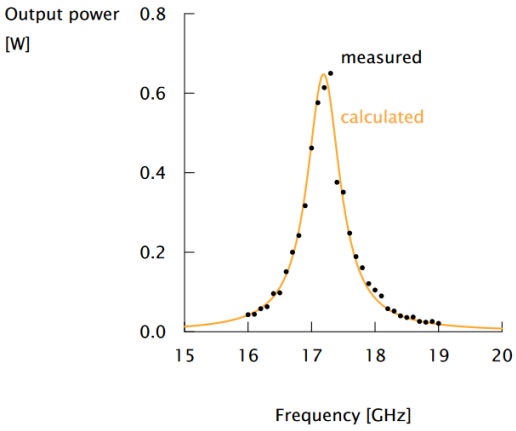


A poor graph

The graph exhibits a very low signal-to-noise ratio, with excessive tick marks and uncalled-for grid lines, and comparatively little ink to represent the data.

The graph is not intuitive, for the separate legend (a key to the symbols) prevents global processing. In a sense, it is a graph to *read*, not a graph to *view*.

58



A good graph

The graph is plainer and therefore better contrasted: the background no longer interferes with the data, yet it provides sufficient information about them.

The graph is more intuitive: the labels, positioned next to the data, provide the required clarification where it is needed (when viewers look at the data).

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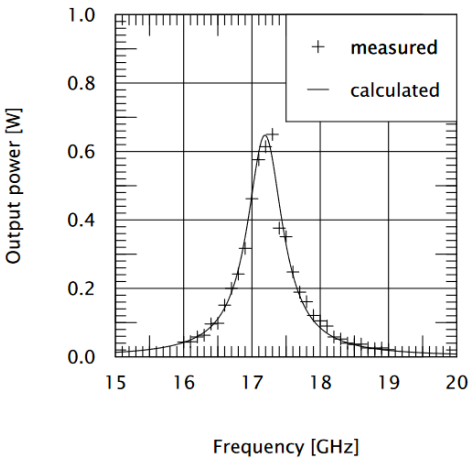

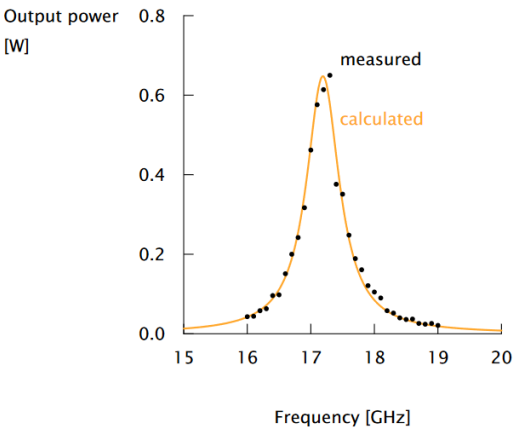

60

Use correct significant figures and give error

	Ce	Gd	Pr
nominal conc (mol fraction)	0.85	0.11	0.04
grain conc (mol fraction)	0.85 ± 0.03	0.10 ± 0.03	0.05 ± 0.01
grain boundary conc (mol fraction)	0.62 ± 0.10	0.26 ± 0.07	0.13 ± 0.03
linear coeff $A \times 10^{-3}$ (mol fraction/deg)	−6.1	3.8	2.1
linear coeff $B \times 10^{-2}$ (mol fraction)	88	9.3	3.6

61

References

- Jean Luc Dumont, "Modern myths: Shortcomings in scientific writing" www.principae.be

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