Bremer Institut für
angewandte Strahltechnik GmbH

Technical Writing II

Writing a Paper

Komkamol Chongbunwatana

SCiE Seminar, 5 May 2009

Outline

- Before Writing
- First Page
- Main Content
- Supplementary Part

Outline

- Before Writing
  - Audience
  - Organization and Structure
- First Page
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Before Writing: Audience

Audience determination:

- Different points of view, interests and academic backgrounds

Example: A paper about Toeplitz matrices

For engineers: Properties and results in terms of the physical problems in which these matrices arise

For mathemeticians: Matrices in isolation from the application

Outline

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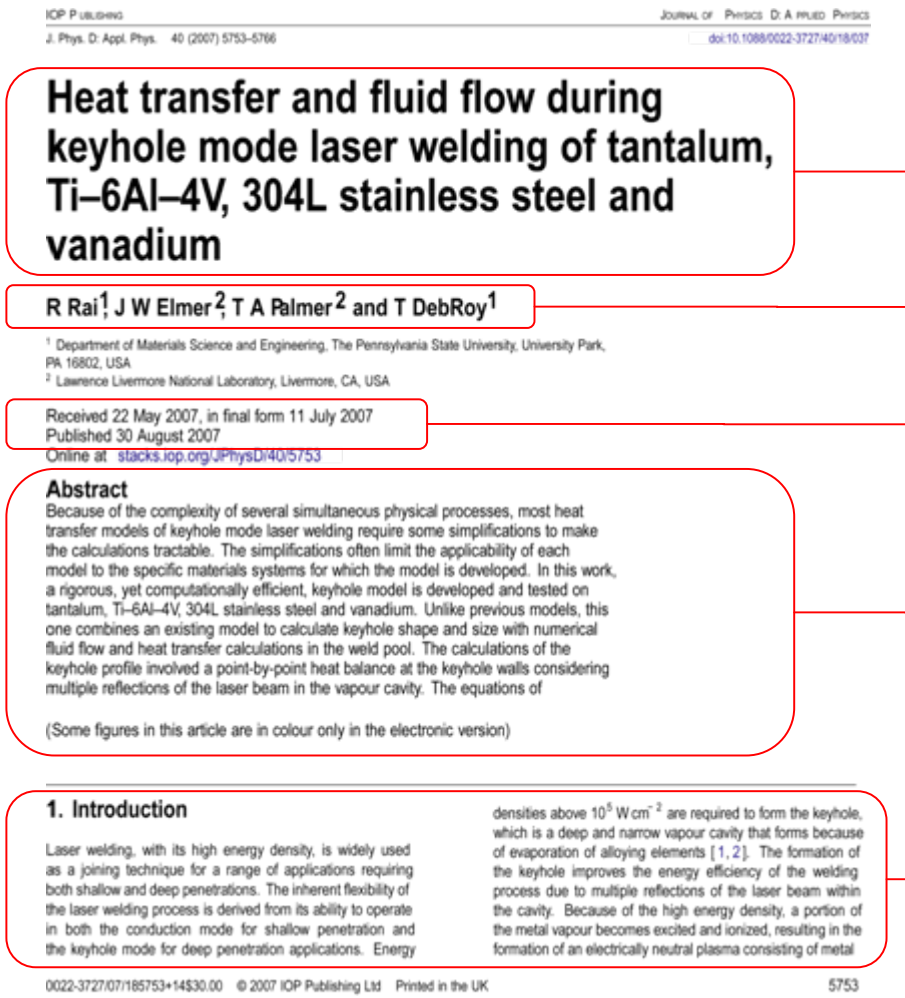
Before Writing: Organization and Structure

Ranking your contributions:

- To identify the most important
- Helping you decide where to put the emphasis and how to present the work as well as helping you write the title and abstract

Before Writing: Organization and Structure

Structure: First page



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Heat transfer and fluid flow during keyhole mode laser welding of tantalum, Ti–6Al–4V, 304L stainless steel and vanadium

→ Title

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→ Date

Abstract

Because of the complexity of several simultaneous physical processes, most heat transfer models of keyhole mode laser welding require some simplifications to make the calculations tractable. The simplifications often limit the applicability of each model to the specific materials systems for which the model is developed. In this work, a rigorous, yet computationally efficient, keyhole model is developed and tested on tantalum, Ti–6Al–4V, 304L stainless steel and vanadium. Unlike previous models, this one combines an existing model to calculate keyhole shape and size with numerical fluid flow and heat transfer calculations in the weld pool. The calculations of the keyhole profile involved a point-by-point heat balance at the keyhole walls considering multiple reflections of the laser beam in the vapour cavity. The equations of

(Some figures in this article are in colour only in the electronic version)

→ Abstract

1. Introduction

Laser welding, with its high energy density, is widely used as a joining technique for a range of applications requiring both shallow and deep penetrations. The inherent flexibility of the laser welding process is derived from its ability to operate in both the conduction mode for shallow penetration and the keyhole mode for deep penetration applications. Energy densities above 10^5 W cm^{-2} are required to form the keyhole, which is a deep and narrow vapour cavity that forms because of evaporation of alloying elements [1, 2]. The formation of the keyhole improves the energy efficiency of the welding process due to multiple reflections of the laser beam within the cavity. Because of the high energy density, a portion of the metal vapour becomes excited and ionized, resulting in the formation of an electrically neutral plasma consisting of metal

→ Introduction

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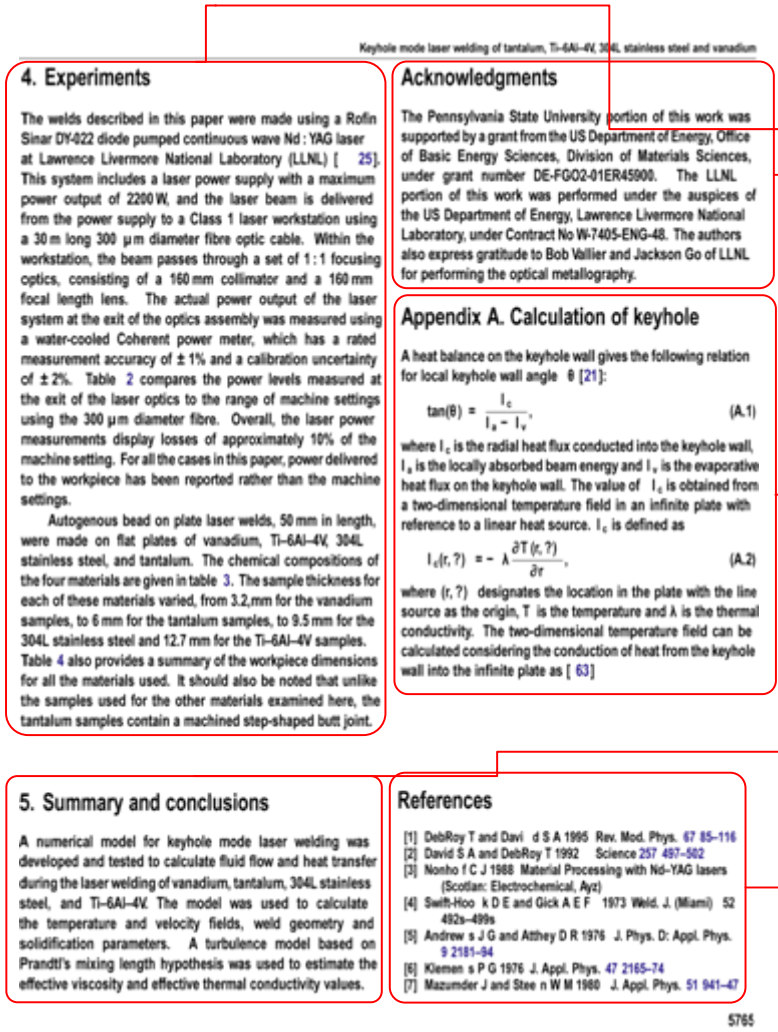
Before Writing: Organization and Structure

Structure: Main content and supplementary part



Keyhole mode laser welding of tantalum, Ti-6Al-4V, 304L stainless steel and vanadium

4. Experiments

The welds described in this paper were made using a Rofin Sinar DY-022 diode pumped continuous wave Nd : YAG laser at Lawrence Livermore National Laboratory (LLNL) [25]. This system includes a laser power supply with a maximum power output of 2200 W, and the laser beam is delivered from the power supply to a Class 1 laser workstation using a 30 m long 300 µm diameter fibre optic cable. Within the workstation, the beam passes through a set of 1 : 1 focusing optics, consisting of a 160 mm collimator and a 160 mm focal length lens. The actual power output of the laser system at the exit of the optics assembly was measured using a water-cooled Coherent power meter, which has a rated measurement accuracy of ± 1% and a calibration uncertainty of ± 2%. Table 2 compares the power levels measured at the exit of the laser optics to the range of machine settings using the 300 µm diameter fibre. Overall, the laser power measurements display losses of approximately 10% of the machine setting. For all the cases in this paper, power delivered to the workpiece has been reported rather than the machine settings.

Autogenous bead on plate laser welds, 50 mm in length, were made on flat plates of vanadium, Ti–6Al–4V, 304L stainless steel, and tantalum. The chemical compositions of the four materials are given in table 3. The sample thickness for each of these materials varied, from 3.2,mm for the vanadium samples, to 6 mm for the tantalum samples, to 9.5 mm for the 304L stainless steel and 12.7 mm for the Ti–6Al–4V samples. Table 4 also provides a summary of the workpiece dimensions for all the materials used. It should also be noted that unlike the samples used for the other materials examined here, the tantalum samples contain a machined step-shaped butt joint.

Acknowledgments

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Appendix A. Calculation of keyhole

A heat balance on the keyhole wall gives the following relation for local keyhole wall angle θ [21]:

$$\tan(\theta) = \frac{I_c}{I_a - I_v}, \qquad (A.1)$$

where I_c is the radial heat flux conducted into the keyhole wall, I_a is the locally absorbed beam energy and I_v is the evaporative heat flux on the keyhole wall. The value of I_c is obtained from a two-dimensional temperature field in an infinite plate with reference to a linear heat source. I_c is defined as

$$I_c(r, ?) = -\lambda \frac{\partial T(r, ?)}{\partial r}, \qquad (A.2)$$

where (r, ?) designates the location in the plate with the line source as the origin, T is the temperature and λ is the thermal conductivity. The two-dimensional temperature field can be calculated considering the conduction of heat from the keyhole wall into the infinite plate as [63]

5. Summary and conclusions

A numerical model for keyhole mode laser welding was developed and tested to calculate fluid flow and heat transfer during the laser welding of vanadium, tantalum, 304L stainless steel, and Ti–6Al–4V. The model was used to calculate the temperature and velocity fields, weld geometry and solidification parameters. A turbulence model based on Prandtl's mixing length hypothesis was used to estimate the effective viscosity and effective thermal conductivity values.

References

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Body

Conclusion

Acknowledgements

Appendix

Reference List

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First Page: Title

According to Kerkut's research:

"For every person who reads the whole text of a scientific paper, five hundred read only the title."

Effective title:

1. Containing a brief discription of the content, to help someone decide whether to read the abstract or the paper itself

2. Catchy enough to attract the attention of a browser

Example: "Computing the eigenvalues and eigenvectors of symmetric arrowhead matrices"

Comment: The title is lively and informative as well as good due to the use of action words like computing.

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First Page: Author List

Writing style: No rules of thumb

Example: Komkamol Chongbunwatana, K. Chongbunwatana, etc.

Muliple authors: Ordering (no rules of thumb)

Examples:

Style 1: The person who did the greatest part of the work first listed
Style 2: Listed alphabetically
Style 3: The academically senior person first listed

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First Page: Abstract

Abstract function:
Summarizing the contents of the paper to enable the reader to decide whether to read the whole paper without having to refer to the paper to understand the abstract

Tips for writing an abstract*:
1. Maximum size between 200 and 300 words 2. Not citing references by number (needing refering to the list of references contained in the paper) in the abstract 3. Avoiding equations in the abstract 4. Making it simple for easy reading 5. Trying not to start the abstract with the common but unnecessary phrases such as “In this paper”

*Those suggestions are particularly relevant for an abstract that is submitted to a conference. Such an abstract will be judged in isolation from the paper, so it is vital to make a strong impression in isolation.

Outline

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First Page: Introduction

Introduction function:

Exciting the uncommmitted reader into reading the whole paper, so a clear, neat, short and imaginative statement is the goal

Tips for writing an introduction:

1. Short (a few hundred words)
2. Defining the problem, explaining what the work attempts to do and outlining the plan of attack
3. Summarizing the results achieved
4. Avoiding general, unexciting statements making the readers bored such as “Polynomials are widely used as approximating functions in many areas of mathematics.”

Knowing the problem and the progress made on it, the reader can decide right after reading the introduction whether to read the whole paper.

Outline

- Before Writing
- First Page
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  - Table
  - Citation
  - Conclusion
- Supplementary Part

Main Content: Table

Techniques for designing a table maximizing the readability:

1. As simple as possible
2. Avoiding repetition; for example, units of measurement or descriptions common to each entry should be once mentioned in the column header
3. Omitting data whose presence cannot be justified and stating only as many digits as needed
4. Comparing quantities by arranging in the column orientation rather than that in row
5. Considering displaying tables containing a large amount of data in an appendix to avoid cluttering the main text
6. Displaying large sets of data as graphs particularly if it is the trends instead of the numerical values that are of interest

Main Content: Table

Good looking table:

No. of processors	Time (secs)	Speedup
1	28.4	-
4	7.2	4.0
8	3.6	7.8
16	1.9	14.7

Poor looking table:

#processors	p =1	p = 4	p = 8	p = 16
Time	28.352197 secs	7.218812 secs	3.634951 secs	1.929347 secs
Speedup	-	3.9275	7.7999	14.6952

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Main Content: Citation

Two main styles of citation:

Number citation: [1]

Number and year citation (Harvard system): [Smith, 1990]

Citation requirements:

1. Not intruding upon a sentence e.g. *“This was found to be unstable [17].”* rather than *“This was found [17] to be unstable.”*
2. Better to incorporate the author's name if the citation is more than just a passing one e.g. *“shown by Jones [5]”*
3. Citing additional information that pinpoints the reference, e.g. a page, section, or theorem number when making reference to a specific detail from a book or long paper e.g. [Smith, 6: 261-301, 1990]

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Main Content: Conclusion

Tips for writing a conclusion:

1. Not just repeating earlier sections in the same words
2. Offering another viewpoint and discussing limitations of the work
3. Giving suggestions for further research by outling open problems and directions for future research

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  - Acknowledgements
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Supplementary Part: Acknowledgements

Who should be thanked?:

1. The must-be-thanked person “any financial support organization”
2. Customary to thank anyone who read the manuscript in draft form and offered significant suggestions for improvement
3. Not thanking someone who was just doing his or her normal work in helping you such as a secretary
4. Trying to avoid thanking anonymous persons to prevent confusion

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Supplementary Part: Appendix

What should be included in an appendix:

Essential information which may distract the reader due to its huge magnitude if it were given at the point where this information is needed such as:

1. Computer program listings
2. Detailed numerical analyses and results

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Supplementary Part: Reference List

In which format should the reference list be written:

"Varying among publishers and journals; however, all publishers have a minimum amount of requirements, so whatever format is to be applied, all required information must be provided"

Example:

SIAM journals:
J. H. WILKINSON, *Error analysis of floating-point computation*, Numer. Math., 2 (1960), pp. 319-340.

Elsevier journals:
J. H. Wilkinson, Error analysis of floating-point computation, *Numer. Math.* 2:319-340 (1960).

“Thank You for Your Attention”