Ceramic Transactions

Proceedings from the MS&T'18 Meeting

Author Guidelines

The Basics

1. **Margins:** Set up your paper (click on File then Page Set Up in MS Word) using 8 ½ x 11 inch Letter paper size and set margins at **0.75-inch** for the top and bottom and **1 inch** for both sides.
2. **Page Limits:** 14 pages or less unless approved by the editor
3. **Font:** All papers are to be created using the **Liberation Serif Font**. This font file can be found and downloaded from the online submission website (under "Instructions and Forms"). All text (including headings and figure captions) should be 12 point (pt) font. Text (including title and headings) should not be bolded.
4. **Spacing and blank lines:** All text must be single-spaced. Insert a blank line (single space) before all headings and subheadings, but not between paragraphs within each section.
5. **Indenting:** Indent each paragraph by one tab and choose justified paragraph alignment for the body of the paper under each heading or sub-heading.

Parts of the paper (see sample paper below)

1. **Title:** The title should be flush left. Letters should all be uppercase except for compounds and chemical formulas (e.g., SiO_2 not SIO2).
2. **Author info:** Flush left, upper and lower case.
3. **Abstract:** The Abstract should not exceed 350 words.
4. **Body text:** Regular text, 12 pt. font, justified type. The first line of text should be indented one tab and should appear directly below the heading (no blank line). Do not use bold, underline, or italics in the text.
5. **Headings and subheadings**
   - Headings: Flush left, 12 pt. font, all uppercase letters (no bold or italics)
   - Subheadings: Flush left, 12 pt. font, upper and lower case (no bold or ital.)

Artwork (Images, tables, graphs)

1. There are two types of figures you may work with in your paper: "line-art" (spot graphs, bar graphs, etc.) and "photo-images" (micrographs, photos, etc.). You will need to supply figures that will look good in a professional publication – that means including each type of figure at specific resolutions or "dots-per-inch" (dpi).
2. Make sure to embed your micrographs, photos and other images (see below under "Embedding Images into a Word document")

3. Photo-images should be at 300 dpi (minimum); failure to do so will result in washed-out and/or blurred images when printed; even if photo-images are not scanned (i.e. the image is already in electronic format), they still must be set to at least 300 dpi for good reproduction.
4. If any line-art must be scanned, it MUST be scanned at 600 dpi (minimum); failure to do so will result in jagged lines when printed. Crop and place images in your electronic document where you want it to appear in the paper.
    - Note: images prepared for the web are set at 72 dpi and make for a very poor product; avoid using images pulled from web-based material.
5. The preferred file formats for any graphics are either EPS for TIFF; using other formats, such as JPG or GIF will decrease the value to some extent.
6. Make sure all type in graphs and figures is large enough to read and understand.
7. Keep all text and artwork within the template margins.
8. COLOR IS ACCEPTABLE, BUT THE PUBLICATION WILL BE PRINTED IN BLACK AND WHITE, SO...Avoid light colors such as yellow, light blue, light green and pink. Delineation between plots in a graph should be indicated by type of symbol and/or line pattern; avoid color graphs where delineation between plots is indicated by color alone.
9. Type the caption under each figure. Number tables with Roman numerals followed by the table title and place above the table.

Extras

1. **Equations:** Equations should be centered and separated from the text by one blank line above and below. Number equations consecutively in parentheses at the right-hand margin, in line with the last line of the equation.
2. **Footnotes:** Identify footnotes with an asterisk (*) and type them at the end of the paper. If more than one footnote appears, identify them with multiple asterisks.
3. **References:** Number references consecutively in the text with superscript numbers, and list corresponding references at the end of the paper.

Embedding images into a Word document

- To insert an image/figure into a Word document, you simply put the cursor where you want the picture to go, click on "insert," then "picture," then "from file." There is no other way to do it.
- It is important to realize that when a figure has type in it, that type will carry all the way over to press. So it is important that the fonts are included at every stage, i.e., they must be embedded in the PDF (see below).
- If a figure is scanned, there are no fonts, just pixels, so fonts are not a problem, but scanned figures must be at high resolution to reproduce well in print.

Embedding fonts in PDFs

This is the procedure for making PDFs with fonts embedded:

1) When “printing*” the Word document to a PDF, click on "Properties" in the print dialogue box.
2) Next click on "Adobe PDF Settings."
3) Then open "Standard."

4) You will then see a tab for "Fonts" to the right. Click on that.
5) Make sure there is a check mark in the "Embed all fonts" box at the top.
6) Make sure there is a check mark in the "Subset and embed . . ." box.
7) The percentage in the window should be "100%."
8) The "When embedding fails" box should say "Cancel job". (This makes it impossible to produce a PDF with missing fonts.)
9) The "Font source" window lists all of the fonts on your system. Highlight all of the fonts on the left, click on the "Add" in the middle, and the fonts will appear in the "Always embed" box on the right. There should be nothing in the "Never embed" window.

Once you make these changes, they should apply to all future PDFs.

*** "Printing" to PDF is actually saving a document as a file; the word "printing" is deceiving in this case.**

FINAL REMINDER: All papers are to be created using the **Liberation Serif Font**. This font file can be found and downloaded at **Liberation Serif Font Download**

SAMPLE OF PROCEEDINGS TITLE: FLUSH LEFT, ALL CAPS, DO NOT BOLD, NO SMALL CAPS

Author Name
Author Affiliation
City, State, Country

ABSTRACT

Text of abstract should not to exceed 250 words. Indent the beginning of each paragraph by one tab. Paragraphs should be single-spaced. Indent each paragraph by one tab and choose justified paragraph alignment for the body of the paper under each heading or sub-heading. Text of abstract should not to exceed 250 words. Indent the beginning of each paragraph by one tab. Paragraphs should be single-spaced. Text of abstract should not to exceed 250 words.

INTRODUCTION

Be sure to set up your paper (click on File then Page Set Up in MS Word) using 8 ½ x 11 inch letter paper size and set for **0.75 inch** margins on the top and bottom and **1 inch** margins on the left and right sides. Please limit your paper to 14 pages or less. All papers are to be created using the **Liberation Serif Font**. This font file can be found and downloaded from the online submission website (under "Instructions and Forms"). All text (including headings and figure captions) should be 12 point (pt) font. Text (including title and headings) should not be bolded.
Please limit your paper to 14 pages or less unless approved by an ACerS staff or the CT Volume editor.

HEADINGS

Headings should be in all capital letters. All headings should be aligned flush left. All text is indented one tab at the beginning of each paragraph. All headings should be in all capital letters. All headings are flush left. All text is indented one tab at the beginning of each paragraph.

Subheading

A subheading is in title case (upper and lower case) and is flush left. An equation should be formatted as below:

$$-\frac{dm_c}{dt} = \frac{DA(c_s - c_0)}{\zeta(t)} \tag{1}$$

A table sample is shown on the following page. Number tables with Roman numerals followed by the table title and place above the table. A table sample is shown on the following page. Number tables with Roman numerals followed by the table title and place above the table. A table sample is shown on the following page. Number tables with Roman numerals followed by the table title and place above the table. A table sample is shown on the following page. Number tables with Roman numerals followed by the table title and place above the table.

Table I. Pilot Scale FBSR Samples Tested in 2003-2004

Demonstration	Sample ID	Total Operating Time (TOT)	Bed Turnover (%)	Description
July 2003 SBW	Bed 260	82 hrs	Unknown	Dynamic bed product
	Bed 272	82 hrs	Unknown	Dynamic bed product
	Bed 277	82 hrs	Unknown	Dynamic bed product
August 2004 LAW	Bed 1103	55 hrs and 30 m	97.4	Dynamic bed product
	Bed 1104	55 hrs and 30 m	99.7	Final bed product
	Fines 1125	55 hrs and 30 m	100	Final filter fines
October 2004 SBW	Bed 1173	100 hours	92	Final bed product

A microphotograph sample is shown below. Number and type a caption under each figure using the same font and size as used in the body of your paper. Do not bold text. Center the figure and caption. A microphotograph sample is shown below. Number and type a caption under each figure using the same font and size as used in the body of your paper. Do not bold text. Center the figure and caption.

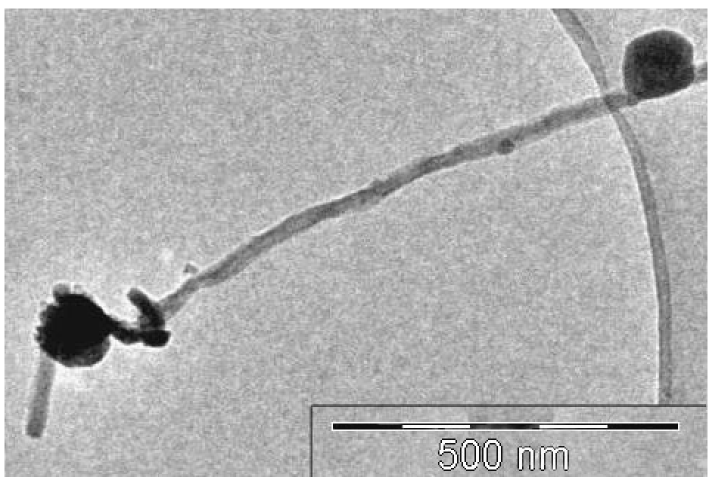

Figure 1. TEM image of spherical nanoparticles attached to a nanocable.

CONCLUSIONS

Each paper should include a concluding paragraph(s).

FOOTNOTES

*Place footnotes here at the end of the paper. Use asterisks to identify the footnotes.
**Place footnotes here.

REFERENCES

[1]Place references at the end of your paper. Use the following format:
[2]E. Traversa, S. Villanti, G. Gusmano, H. Aono, and Y. Sadaoka, Design of Ceramic Materials for Chemical Sensors: $SmFeO_3$ Thick-Films Sensitive to NO_2, *J. Am. Ceram. Soc.*, **82**, 2442-50 (1999).

CHARACTERIZATION OF SILICON CARBIDE MICROSTRUCTURE USING NONDESTRUCTIVE ULTRASOUND TECHNIQUES

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Piscataway, NJ, USA

ABSTRACT

Ultrasonic nondestructive evaluation has conventionally been used to measure elastic properties and locate large flaws in many types of materials used for a number of different applications. Recent advances in acoustic spectroscopy have enabled ultrasound techniques that can be used to examine the microstructure of dense ceramic bodies. In this study, methodology is developed for nondestructively characterizing the microstructure of spark plasma sintered (SPS) silicon carbide using high frequency ultrasound acoustic spectroscopy. Several silicon carbide samples with varying microstructures were produced by varying the processing and sintering conditions. Comparison of the acoustic attenuation spectra of the silicon carbide samples with microstructural information from field emission scanning electron microscopy (FESEM) is used to determine a relationship between microstructural properties and ultrasound response.

INTRODUCTION

Silicon carbide ceramics are frequently used in many demanding applications due to their excellent mechanical and thermal properties. In order to ensure the performance of the material, testing should be performed on a finished part before being put into service. Conventional testing methods for ceramic parts are typically destructive processes that render the specific parts tested unfit for service. Nondestructive methods do exist and are able to determine some material properties without harming the tested part. This enables all parts to be tested to ensure quality before entering service. One common nondestructive evaluation method uses ultrasound to determine the elastic properties of a material and can locate large cracks or other flaws[1]. While this method is effective at locating large flaws, it does not provide any information about the underlying microstructure.

This research was conducted in order to study the interaction of high frequency ultrasound and the microstructure of silicon carbide prepared via spark plasma sintering (SPS). Silicon carbide samples made with boron carbide and carbon additives were examined using nondestructive ultrasound techniques………………………..

EXPERIMENTAL

In the effort to create SPS SiC samples with varied microstructures, different SPS sintering cycles were utilized. For this work, samples were made with variations in applied pressure, sintering temperature, and dwell time at the sintering temperature. To make these samples, silicon carbide powder was mixed with boron carbide and carbon additives by ball milling in ethanol for 24 hours in a polyethylene container with silicon carbide balls. Each sample used the same Saint Gobain SiC powder, 1.5% Fisher lamp black as the carbon additive, and 0.5% H.C. Starck HD20 as the B_4C additive. After milling, the powders were sieved to remove the ball mill media, pan dried, ground to uniformity with a mortar and pestle, and left to dry in an oven at 115°C overnight.

The samples were then densified in a Thermal Technology SPS 10-4 spark plasma sintering unit using 6.5 grams of powder in a graphite die lined with graphite foil. The pressure variation samples were sintered by first heating under vacuum to 1400°C at 200°C per minute under 10 – 50MPa uniaxial pressure and holding for 5 minutes……………………………….

Table I. SPS conditions used for each sample.

Sample	Applied Pressure (MPa)	Sintering Temperature (°C)	Dwell Time (min)
Pressure Variations			
50MPa	50	1900	15
40MPa	40	1900	15
30MPa	30	1900	15
20MPa	20	1900	15
10MPa	10	1900	15
Temperature Variations			
1900C	50	1900	5
1925C	50	1925	5
1950C	50	1950	5
1975C	50	1975	5
2000C	50	2000	5
Dwell Time Variations			
5 min	50	2000	5
15 min	50	2000	15
25 min	50	2000	25
35 min	50	2000	35
45 min	50	2000	45

RESULTS AND DISCUSSION

Pressure Variations

The densities and elastic properties of the pressure variation samples are shown below in Table 2. Figure 1 below shows FESEM images of the pressure variation samples. The samples all show similar size and shape of the SiC grains with relatively small, equiaxed grains and small, evenly distributed secondary phase particles of unreacted B_4C and carbon. The main differences are in the amount of porosity observed in the samples sintered at lower pressures. Very little if any porosity is seen in the samples sintered at 50 and 40MPa. Those sintered at 30 and 20MPa show a moderate amount of porosity and the sample sintered at 10MPa shows a significant level of porosity. This increase in porosity is also reflected in the differences in density between samples……………………………………………

Table 2: Pressure variation sample elastic properties.

Sample	c_L (m/s)	c_S (m/s)	Poisson	Density (g/cm^3)	E (GPa)	G (GPa)	K (GPa)
50MPa	11961	7422	0.187	3.16	413	174	220
40MPa	11942	7437	0.183	3.14	411	174	216
30MPa	11811	7365	0.182	3.09	396	168	208
20MPa	11830	7376	0.182	3.08	396	168	208
10MPa	11356	7053	0.186	2.94	347	146	184

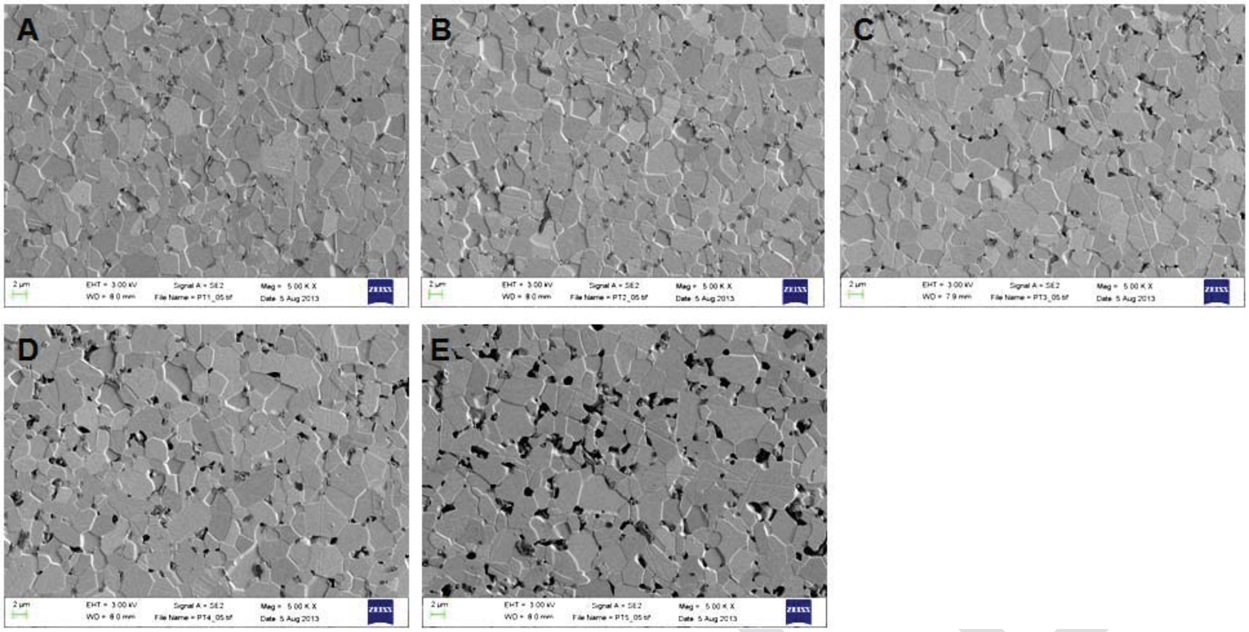

Figure 1. FESEM images of samples sintered with 50MPa (A), 40MPa (B), 30MPa (C), 20MPa (D), and 10MPa (E) of applied uniaxial pressure at 5000x magnification.

CONCLUSIONS

Several sets of silicon carbide samples were made using the spark plasma sintering method. The sintering parameters were varied in order to produce samples with varying microstructures. Ultrasonic testing was performed to measure elastic properties and to correlate measured attenuation coefficient spectra to microstructural characteristics. In samples that were sintered with varying amounts of applied pressure, it was shown that the attenuation coefficient increased at high frequencies with increasing porosity……………..

ACKNOWLEDGEMENTS

The authors would like to thank the NSF IUCRC Ceramic, Composite, and Optical Materials Center for its support.

REFERENCES

[1] ASTM Standard E1001, 2011, "Standard Practice for Detection and Evaluation of Discontinuities by the Immersed Pulse-Echo Ultrasonic Method Using Longitudinal Waves," ASTM International, West Conshohocken, PA, 2011, DOI: 10.1520/E1001-11, www.astm.org

[2] Bottiglieri, S., & Haber, R. A. (2010). High Frequency Ultrasound of Alumina for High Strain-Rate Applications. *Advances in Ceramic Armor V*, 91-103.

[3] Bottiglieri, S., & Haber, R. A. (2010). Corrective Techniques for the Ultrasonic Nondestructive Evaluation of Ceramic Materials. *Advances in Ceramic Armor VI: Ceramic Engineering and Science Proceedings, Volume 31*, 57-67.