Author Guidelines – UNITECR 2021

All presenters (oral and poster) must submit a paper in order to participate in the UNITECR meeting. The two choices for publication are: 1) Peer reviewed in the International Journal of Ceramic Engineering & Science (IJCES) or 2) the general conference proceedings.

JOURNAL INSTRUCTIONS

Presenters who wish to have their papers peer reviewed in the International Journal of Ceramic Engineering & Science (IJCES) must submit work at https://mc.manuscriptcentral.com/ijces. Submissions must be in a Word document, and the proceedings format (below) is acceptable. Please indicate “UNITECR” in the article processing charge (APC) section to receive the automatic fee waiver. Manuscripts will be peer reviewed and must be accepted by the editorial committee. All papers will also appear in the proceedings and will be designated as being in peer review or accepted by IJCES as appropriate. Early submission by **October 1, 2021** for possible acceptance in time for UNITECR. The absolute submission deadline to receive the APC waiver is **November 1, 2021**.

PROCEEDINGS INSTRUCTIONS

Authors who do not submit to IJCES are required to submit a paper for the collected UNITECR 2021 proceedings. Proceeding manuscripts should be submitted as “camera-ready.” Your submitted paper must be approved but they **will not** be edited before posting online. The proceeding collection will be made available to registrants of the conference.

Final papers should be e-mailed to Greg Geiger (ggeiger@ceramics.org) as a MS Word document. Papers will be converted to a pdf file before posting online. The **deadline for submission is December 1, 2021**.

Please read and follow the guidelines below.

The Basics

1. **Page Limit:** Papers cannot exceed 8 pages.
2. **Margins:** Use 1-inch margins on all sides when using 8 ½ x 11 inch paper. For A4 paper, use 2.5 cm (1 in) on the top, 2.2 cm (0.9 in) on the sides and 4.4 cm (1.7 in) on the bottom.
3. **Two Column**: Except for title and author information on the top of the first page, each page should be separated into two columns and the columns must have a gutter space of 7 mm (0.25 in). (You can cut and paste using the template provided or you may refer to MS Word template or choose Format/Columns).
4. **Font:** All text must be in 12 point Times or Times New Roman
5. **Spacing:** All text must be single-spaced. Add a space before each heading or subheading.

6. **Indenting:** Indent each paragraph by one tab.

Parts of the Paper

1. **Title:** The title should be centered at the top of the page. Letters should all be uppercase except for compounds and chemical formulas (e.g., Al_2O_3 not AL2O3), do not bold. Use 12-point Times or Times New Roman font.
2. **Author info:** Begin the author information centered two lines below the last title line. Use upper and lower case, 12-point Times or Times New Roman font. The presenter of the paper should be marked with an asterisk (*) after the last name.
3. **Body text:** Text should be 12-point Times or Times New Roman font. The first line of text should be indented one tab and should appear directly below the heading (no blank line). Text alignment should be justified.
4. **Headings and subheadings**
    - Headings: 12-point Times or Times New Roman font, all uppercase letters (no bold or italics).
    - Subheadings: 12-point Times or Times New Roman font, upper and lower case letters (bold or italics is optional)
5. **Spacing:** Between the last line in the author information and the first main heading, there should be one space and then one continuous section break (To insert a continuous section break, choose “Insert,” then “Break” and then click on the radio button next to “Continuous.”).

Illustrations, Tables, etc.

1. **Figures:** Figures in the text must be indicated in the form of “Fig. 1” followed by a brief description in 12 point font and place below the figure.
2. **Tables:** Number tables with Roman numerals (i.e.; I, II, III, etc.) followed by the table title and place above the table.
3. **Units:** The International System of Units (SI) must be used to indicate units.
4. **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.
5. **References:** Number references consecutively in the text with superscript numbers, and list corresponding references at the end of the paper.

Sample paper: A sample paper can be found on the following 2 pages.

REACTION CHEMISTRY AND MICROSTRUCTURE DEVELOPMENT OF MgO-C REFRACTORIES CONTAINING METAL ANTIOXIDANTS

J.P. Guha* and J.D. Smith
University of Missouri-Rolla, USA

ABSTRACT

Phase formation and their stability during firing MgO-C refractories with minor additions of Al-metal were studied at temperature between 600^o and 1200^{o}C in an atmosphere of argon. The phases formed at different stages of the reaction process were identified by powder x-ray diffraction and scanning electron microscopy. At the initial stages of the reaction process, a liquid phase containing Al and Mg, was formed at a temperature below the melting point of Al-metal (660^{o}C). The liquid, once formed, coexists with MgO and C at temperatures up to 850^{o}C and then slowly dissociates to molten Al and Mg-gas above this temperature. With the continuation of the reaction, the molten Al reacted with C to yield Al_4C_3 in the form of thin platelets, whereas, the Mg-gas combined with the oxygen present in the furnace to yield MgO in the form of whiskers on the cold-face of the refractories. At temperatures above 1000^{o}C, Al_4C_3 reacts with MgO to form spinel, $MgAl_2O_4$. Since $MgAl_2O_4$ is compatible with both MgO and C, no further reaction occurred in the refractories.

INTRODUCTION

For the last several years, refractories based on MgO and C, which are known to possess excellent resistance to thermal shock and slag-corrosion at elevated temperatures, have found extensive application in steel-melting processes, especially, in the basic oxygen furnace (BOF). However, the life of these refractories becomes somewhat limited on prolonged use under severe operating conditions due mainly to poor oxidation resistance and low strength of these materials at high temperatures. During the last several years, several studies1-6 have been carried out to improve the service-life of these refractories by (i) using high-purity starting materials, (ii) controlling the grain-size of MgO, and (iii) addition of small amounts of metal and metallic alloys to the starting compositions. It has been recognized in these studies that the property enhancement of these refractories takes place by the interactions of the metallic additives with MgO and C leading to the formation of several secondary phases, which coexist with MgO. In general, the metal and/or alloy preferentially react with C at a significantly low temperature to yield metal carbides, which, once formed, remain stable as a discrete phase in the bulk of the specimens. Thus, Al-metal reacts with C to form Al_4C_3, whereas, Si-metal reacts with C to yield SiC. It is generally believed that the presence of one or both of these carbides in the bulk of the specimens leads to an enhancement of the hot-strength of the refractories.

A major problem of high-temperature use of the MgO-C based refractories is the carbothermal reaction that occurs between MgO and C at temperatures above 1500^{o}C. This reaction leads to a partial loss of both Mg and C from the refractories as shown by the following equation:

$$MgO_{(s)} + C_{(s)} \overset{>1500^oC}{\Leftrightarrow} Mg_{(g)} + CO_{(g)}$$

Thus, on prolonged exposure to temperatures above 1500^{o}C, Mg-vapor is formed and progressively removed from the interior to the cold surface of the refractories. As the Mg-vapor comes in contact with the oxidizing atmosphere in the furnace, it reoxidizes to MgO and forms a dense layer adjacent to the hot-face of the refractories. The formation of this MgO layer leads to an increase in the oxidation resistance of the material during operation at high temperature.

RESULTS AND DISCUSSION

From the various data obtained in this investigation, it was observed that Al preferentially reacts with MgO at a temperature below the melting point of Al (660^oC) to yield a metallic alloy composed of Al and Mg. It is evident from the phase diagram of the system Al-Mg_7 that two binary compounds i.e. Al_3Mg_2 and $Al_{12}Mg_{17}$ occur within a small homogeneity range. The phase diagram also shows that both the compounds melt at temperatures below 500^oC. Thus, the reaction of Al-metal with MgO, which seemed to commence at a temperature below the melting point of Al, led to the formation of a Al-Mg phase, which was found to be molten at the reaction temperature. It was further observed that the stability of this metallic phase was largely dependent on the firing temperature and the oxygen partial pressure prevailing in the furnace during firing. Evidence obtained in this investigation indicated that this metallic phase coexists with MgO up to 850^oC and then dissociates into molten Al and Mg-vapor above this temperature. It should be noted that the dissociation of this metallic phase largely depends on the rate of heating of the specimens. Thus, with a heating rate of 10^oC/min, the Al-Mg phase was found to dissociate at a temperature above 850^oC. Microstructures of several compositions containing MgO with minor additions of Al, which were fired at temperatures between 600^o and 1000^oC, revealed the presence of a reaction product in the form of a molten mass embedded in a fine-grain matrix of MgO. A SEM micrograph of a specimen containing 10 wt % Al, which was fired at 1000^oC in argon, is shown in Fig.1.

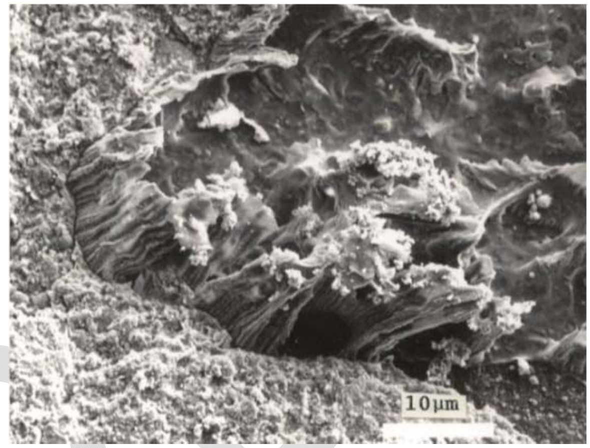

Fig. 1. SEM micrograph of MgO containing 10 wt% Al. The specimen was fired at 1000^oC for 1h in argon.

REFERENCES

1. A. Watanabe, H. Takahasi, T. Matsuki and M. Takahasi, “Effects of Metallic Elements Addition on the Properties of Magnesium Carbon Brick”, Proc. 1st Int. Conf. on Refract., Tokyo. Japan, pp 125-34 (1983).

2. A. Watanabe, H. Takahasi, T. Matsuki and M. Takahasi, “Some Properties of Magnesia-Carbon Bricks Containing Mg and Al”, Taikabutsu Overseas, 5 [2] 7-12 (1985).

3. A. Yamaguchi and T. Matsuda, “The Effect of Al and Alloy Additions on the Properties of Carbon-Containing Refractories”, Proc. 2nd Conf. on Refract., Tokyo, Japan, pp. 915-24 (1987).