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Hot Stage Microscope

Introduction

Heating microscopy thermal analysis (HMTA) is the blend of microscopy and thermal analysis to facilitate the study and physical characterization of materials as a function of temperature and time. This technique is relatively simple and inexpensive. The results could be obtained in a fast and accurate way. By varying the temperature, the sintering point and the melting point of a substance can be determined. Further, sample preparation is quite easy. It is worth to say that this technique works in oxidizing atmosphere and the heating rate is 10°C/min.

Sample Preparation

The sample preparation for the hot stage microscope has two main processes. First step is to grind the sample to be fine as like as sand grains (about 0.1mm) and in case of mixture of different powders, it is important to take care about the homogenization. Second step is to put a proper amount of the prepared sample powder in the small metal mold, which has a cubic dimension of 3mm^3. Finally, the sample should be placed on a Corundum plate.

Test Procedure

The prepared sample has to be placed in the alumina pipe with 19mm diameter and 200mm length. The sample should be sited on the small arm, with 15mm diameter and 150mm length, which is inserted into the furnace. The camera shows the live picture of the sample during the heat treatment and macroscopic changes in sample dimensions can be observed. Figure 1 shows a schematic set-up of the hot stage microscope.

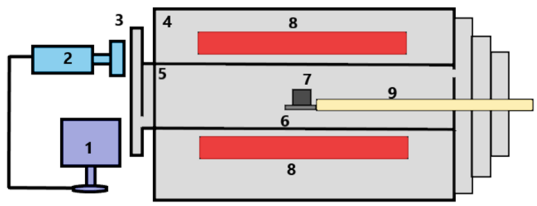

Figure 1 - Schematic experimental setup of hot stage microscope. 1 recorder; 2 microscope camera; 3 quartz window; 4 furnaces; 5 alumina tube; 6 stage; 7 sample; 8 heating element; 10 moving arm.

Expected Result

This test gives the shrinkage pictures of the sample. Figure 2 demonstrate the picture of industrial flux sample which has mixed with MgO-C at 52°C, 1200°C, 1300°C and 1400°C respectively. Figure 3 displays the shrinkage curve obtained with this test, with respect to equation from reference [1]. A dimensional variation corresponding to the −2% with respect to the first image acquired, which is taken to be 100%, were determined.

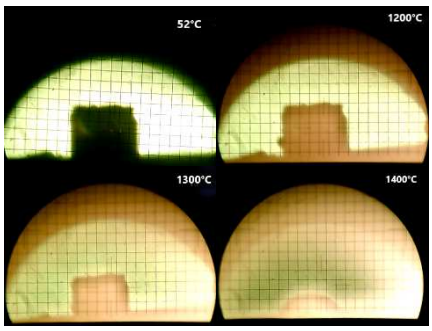

Figure 2 - Heating microscope images.

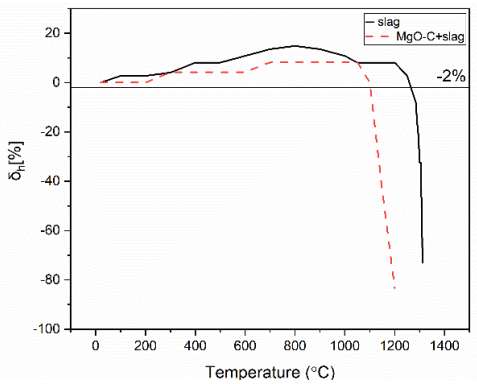

Figure 3 - Expected results.

Acknowledgments

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References

[1] Madej, Dominika, and Jacek Szczerba. "Detailed studies on microstructural evolution during the high temperature corrosion of SiC-containing andalusite refractories in the cement kiln preheater." Ceramics International 43.2 (2017): 1988-1996.

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