

Susceptor Investigation for Microwave Heating Applications

Morgana Fall, Gabrielle Gaustad, Dr. Holly Shulman Ceralink, Inc. · NYSCC · Alfred University

Introduction

Microwave Hybrid Heating = Susceptor + Microwave Energy

- Microwave : volumetric heating (coupling)
- Susceptor: radiant heating

Susceptors couple well at RT

- Provide initial heat transfer
- Decrease inverse temperature profile

Variables

- Susceptor type, mass
- Thermal package volume
- Firing temperature

Conclusions

Choose susceptor mass that's best for desired firing temperature!

There is an ideal susceptor mass for different firing temperatures
due to inverse between susceptor mass and max heating rate for constant microwave power
resulting in

- Too much susceptor slows heating initially
- Too little susceptor slow at high temp
- Low temp use less susceptor mass; higher temps need more susceptor mass

In addition

- Maximum heating rate gives minimum energy consumption
- Smaller volume thermal packages have higher max heating rates

Experimental Procedure

• ThermWave Microwave Unit – Figure A

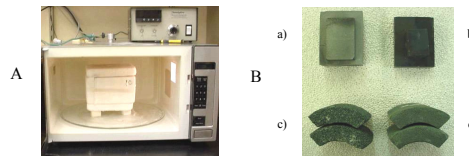
- 1.3 kW, 2.45 GHz, Research Microwave Systems (RMS)

SiC Materials- Figure B

- Course grinding grade
- Hexalloy®- Saint-Gobain Advanced Ceramics
- RMS course and fine grade Thermcepts

Experiments

- Effect of susceptor mass on heating in a constant volume (460 cm³)
- Effect of thermal package volume on heating w/ constant susceptor mass

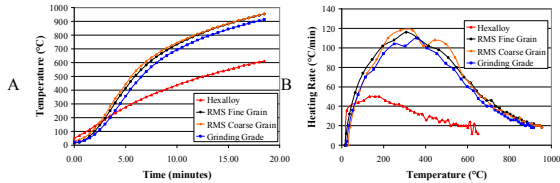


Susceptor Type

Max. Heating Rate and Temperature

- Fine and course RMS identical
- Grinding grade similar to RMS
- Hexalloy® had lowest rate

SiC (type)	Max. Temp. (°C)	Max. Rate (°C/min.)
Hexalloy®	611	50
Grinding Grade	915	110
Coarse Grain	955	120
Fine Grain	955	120



Susceptor Mass

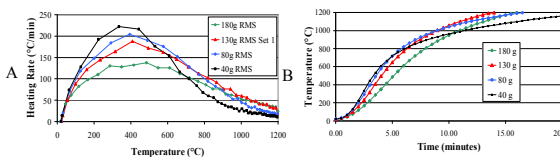
Susceptors mass / Ideal heating range

- 40 g RT-500 °C
- 80 g 500-800 °C
- 130 g > 800 °C
- 180 g >1150 °C

• Figure A: max heating rate and mass show inverse relationship

- 40 g 225 °C/min
- 180 g 145 °C/min

• Figure B: 130 g had fastest heat up to 1200 °C



Thermal Package Volume

Figure A: time to temperature

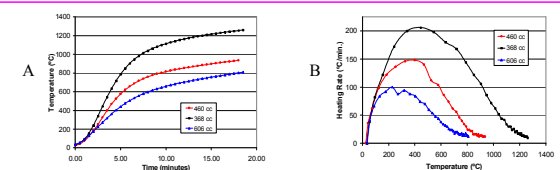
- 368 cm³ had shortest time
- Trend: larger volume- longer time

Figure B: max heating rates

- 370 cm³ - over 200°C/min
- 460 cm³ - 150 °C/min
- 610 cm³ - 100 °C/min

Volume effect experiments

- 54 g of RMS fine grade susceptor at RT
- Thermal package volumes of 370, 460 and 610 cm³



Energy Consumption

Energy consumption vs. susceptor mass

• Energy Efficiency Depends on Susceptor Mass and Firing Temperature

- 1200°C firing shows minimum consumption at 130 g
- 600°C less mass (50 g), is more efficient

