Abstract: Magnesium Oxide (MgO) molded into a cylinder and placed in a Boron Epoxy cube was compressed to an estimated 5 GPa of hydrostatic pressure and then subjected to high heat (1020 C), quenched (30 C), and heated again (1200 C). X-ray diffraction (XRD) data was taken at five locations inside of the sample in order to determine the d-spacing and cell volume of the cubic crystal. Analysis of this data revealed a temperature gradient within the sample. This gradient suggests that either heat is bleeding out of the sample end caps of the cylinder, or that increased resistance in the furnace is causing a hot spot in the center.

Experimental Apparatus

Results

Conclusion: From the data obtained during the three runs it appears that various phenomena are causing a temperature gradient inside the sample. If the differences in d-spacing were due to other effects such as preferred orientation, other indications would have appeared in the high T data. Any physical deformity in the sample due to flow or impurities would have been ‘frozen in’ during the quenched run. As this run does not mirror the high T data, this does not appear to be the case. Therefore variations in d-spacing at high T are likely temperature gradient related. The gradient is steeper at higher T, which lends credence to two possibilities. The first is that heat is bleeding out of both ends of the sample. Whether this is due to the cylindrical geometry or the thermal properties of other cell elements (alumina notably) is not clear. The other possibility is that it is a heater effect. The two thermocouples break the furnace wall, increasing its resistance in the center. This leads to higher heat generation at position 3. The physical reality is probably a combination of these two. An experiment without thermocouples is necessary to verify this. Any experiment that relies on precise temperature readings (such as melt point experiments) must contend with this heat gradient. Changes in cell design may reduce the gradient’s intensity.

Acknowledgements:

References

Analysis done in Excel and PlotBS
