

## **Characterization of Shape-Preserving Diatom Displacement Reactions using High Temperature X-ray Diffraction**

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Shape preserving displacement reactions of the type  $2\text{Mg(s)} + \text{SiO}_2\text{(s)} > 2\text{MgO(s)} + \{\text{Si}\}$  and  $\text{TiF}_4\text{(g)} + \text{SiO}_2\text{(s)} > \text{TiO}_2\text{(s)} + \text{SiF}_4\text{(g)}$  where the  $\text{SiO}_2$  is in the form of diatoms were studied using high temperature x-ray diffraction (HTXRD) with the samples sealed inside graphite reaction vessels. Enclosure of the sample within the graphite cell allows for containment of the vapor formed during the reaction ( $\text{Mg(g)}$  and  $\text{TiF}_4\text{(g)}$  respectively). Reactions of this type allow for complete conversion of the complex-shaped  $\text{SiO}_2$  diatom frustule to alternate chemistries (such as  $\text{MgO}$  and  $\text{TiO}_2$ ) with no loss of structural features. HTXRD measurements show complete conversion of  $\text{SiO}_2$  to  $\text{MgO}$  after approximately one hour at  $700^\circ\text{C}$ , and after 45 minutes for  $\text{SiO}_2$  to  $\text{TiO}_2$  at  $300^\circ\text{C}$ . The kinetics of both reactions were also probed using isothermal measurements.

**Keywords:** diatoms, shape preserving, displacement reactions