

Richard Blair

## **Mechanically Driven Condensation Reactions for Solid-State Synthesis**

Typical synthetic approaches for the production of oxides involves extensive heating and grinding. We have found that the formation of pyrochlores such as  $\text{Na}_2\text{Ta}_2\text{O}_6$ , perovskites such as  $\text{CaTa}_2\text{O}_6$  and spinels such as  $\text{ZnAl}_2\text{O}_4$  can be realized by vigorously grinding hydroxide and oxide mixtures. The formation of the desired material is enthalpically driven, but condensation only occurs upon the application of mechanical force. This has allowed us to thoroughly study the reaction kinetics using techniques similar to quenching high-temperature reactions. We have found that the synthesis of the pyrochlore  $\text{Ca}_2\text{Ta}_2\text{O}_7$  from  $\text{Ca}(\text{OH})_2$  and  $\text{Ta}_2\text{O}_5$  goes through a crystalline intermediate perovskite phase-  $\text{Ca}_4\text{Ta}_2\text{O}_9$ . Syntheses can take as little as one hour to go to completion. This new route will facilitate the preparation of isomorphously substituted oxides for a wide array of uses such as catalysis and lighting.