

**MATERIALS ENGINEERING
SEMINAR**

**“DEFECT ENGINEERING AND PROPERTY TUNING ON RUTILE TITANIUM OXIDE THROUGH
FIELD-ASSISTED SINTERING”**

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ABSTRACT

The flash sintering technique is an attractive rapid densification process that was first introduced in 2010. Its unique ability to densify ceramic materials in seconds is accomplished by the combination of thermal energy from the furnace and the electrical power introduced by the external electric field. Such a non-equilibrium process is capable of introducing various classes of defects such as oxygen vacancy, dislocation, stacking fault, twin boundary, and secondary phase. In ceramic materials, defects have a profound impact on the properties of the materials in many aspects. Therefore, flash sintering is not only a novel sintering method that can reduce the energy consumption by avoiding prolonged high-temperature sintering but also can be an effective way to perform defect engineering on the ceramic materials to better tune the properties for specific applications. However, limitations such as microstructural gradients severely restrict the use of the flash sintering technique. Further investigations in microstructure and defect control are crucial to prepare flash sintering technique to more applications.

In this dissertation, rutile TiO_2 was selected as the model system to better elucidate the flash sintering mechanism and explore the influence of electric field on the microstructure distribution. Rutile TiO_2 is a highly versatile ceramic material with extremely broad applications including microelectronics, photocatalysis, water/air purification, and food additives. The oxygen vacancies and dislocations that can be introduced by the flash sintering method play crucial roles in many applications of TiO_2 . Furthermore, the defect chemistry of rutile TiO_2 has been thoroughly investigated, providing a solid foundation for this study. To understand the defect concentration necessary to achieve optimal properties, detailed investigations on the influence of oxygen vacancy concentration on the deformation behavior of rutile TiO_2 were carried out. These findings shed light on the future route for the rapid fabrication of ceramic materials with enhanced properties.

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