Abstract

Thermal conductivity of nuclear fuel has a huge impact on the efficiency of a nuclear power plant as it dictates the power levels that the plant can be operated at. Ever since the inception of Uranium Dioxide as fuel for power plants, researchers have been on the lookout for methods to improve its thermal conductivity, or its basic ability to conduct heat out from within. Contributions from the composite materials community have provided important insights into the problem with potential solutions. The higher thermal conductivity of Silicon Carbide, along with its other prominent reactor-grade properties, makes it a potential material to address some of the related issues when used with UO₂.

The present research, in collaboration with the University of Florida, is aimed at investigating the feasibility, and developing a formal methodology, of producing this Composite Oxide Fuel for near term deployment in LWRs.

Principally divided into three parts, the study first establishes the enhancement achievable in the effective thermal conductivity of the fuel. Keff values calculated using the commercial software FLUENT will be discussed along with heat flow simulations within the fuel, which show the reduction achievable in centerline temperatures and the consequent positive effect on the limits of operability. The second part involves the actual manufacturing procedure for the fuel, (being) carried out at UFL. The third part will address issues of in-reactor performance of the fuel ranging from initial calculations of required U-235 enrichment to predicting reactor transients and thermal hydraulics. Estimates of the required enrichment calculated by reactor-codes Combine-PC and Venture-PC will be discussed.