CHEMICAL VAPOR DEPOSITION OF POROUS SILICON CARBIDE ONTO CERAMIC MICROSPHERES USING A FLUIDIZED BED REACTOR

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To Mom and Dad, who instilled in me the value of an education and have supported me though all of mine.

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ABSTRACT

Slaga, Amy C. M.S.N.E., Purdue University, August, 2006. Chemical Vapor Deposition of Porous Silicon Carbide onto Ceramic Microspheres using a Fluidized Bed Reactor. Major Professor: Sean M. McDeavitt.

The Gas Fast Reactor (GFR) program in the United States requires novel nuclear fuel materials to achieve the fuel performance requirements for a fast neutron spectrum at high temperatures. Previous studies have shown that uranium carbide coated with a porous silicon carbide (SiC) layer and a dense SiC layer performs well in GFR conditions. A known process for coating the fuel is to suspend the microspheres in a fluidized bed (FB) reactor, flow a combination of gases over the particles to produce SiC on the surface of the particles through chemical vapor deposition (CVD). This thesis focuses on the use of methylsilane (CH_3SiH_3) as a SiC precursor, the experiment built at Purdue University's Fuel Cycle and Materials Laboratory (FCML) to test it, and the results of that experiment.

The experiment utilized two designs for a fluidized bed that resulted in eleven coating runs. Of these coating runs, the last three demonstrated that a porous and a denser layer of SiC deposited on ceramic microspheres may be produced from a fluidized bed reactor using methylsilane gas. These experiments were conducted at 1200˚C and 900˚C, where the porous layer is deposited at 1200˚C and the denser layer is deposited at 900˚C. The last three coating runs used a total deposition time of one hour, three hours, and five hours and resulted in coating thicknesses of 3.58 ± 0.32μm, 10.18 ± 1.68μm, and 95.32

± 1.03μm respectively. The deposition rate for this system is approximately 0.05μ/min for 900˚C and 0.06 μ/min for 1200˚C.