

Advanced Silicon Carbide from Molecular Engineering and Actinide Fuels

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In the frame of nuclear fuels studies for generation IV, carbides or oxycarbides assemblies are one of the engaged material for high temperature reactors. The design of the fuels is not yet defined but some structures are actually considered with SiC as matrix for the actinide fuel (fig 1).

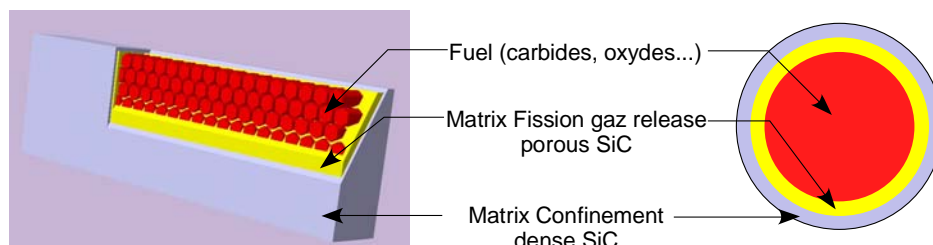


Figure 1: Example of generation IV fuel structure

In this work we have studied the synthesis of a multiscale structure controlled SiC matrix using molecular silicon organometallic precursors (fig 2).

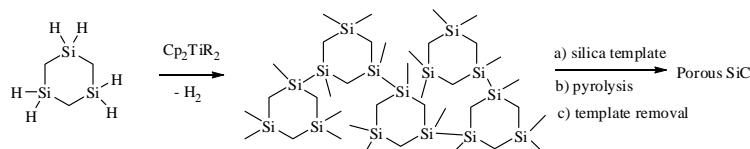


Figure 2: Synthesis of SiC by molecular engineering.

The aim of this work was to develop a way to obtain multiscale SiC matrix material which could be engineered to fit in any fuel structure defined for generation IV fuels. The control of this multiscale structure was done using several templating methods specific of the low temperature solution synthesis of the precursor.

In a first step, we have focused our effort on the synthesis of the SiC material. A first level of template was successfully done by the use of solid silica 500 nm balls. A second level of template was studied by the use of mesoporous silica, structured at a 50 nm level. At least, supramolecular templating in non aqueous media was considered with the difficulty to build a molecular assembly (inverse micelles).

In a second step, we have functionalized the primary silane phase with actinide complexing agent in order to blend directly the actinide inside this primary phase in a controlled way (figure 3).

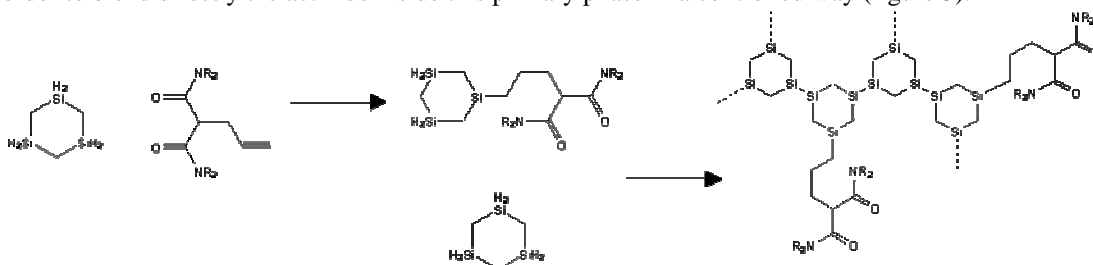


Figure 3: Functionalisation of silane phase.

During these studies, a new one pot synthesis route to obtain the functionalized primary silane phase was developed.