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Simulation of grain morphology evolution during sintering

In the nuclear fuel industry, sintering is one of the key steps in the manufacturing fuel pellets. This process is driven by the solid-state diffusion of the ceramic, here either undoped/doped. At the microscopic scale, the green pellet consists of UO2 grain clusters. During the sintering, microstructure evolution depends on the competition between bulk, surface and grain boundary diffusion, which govern densification and grain growth.
Densification is mainly determined by grain boundary and bulk diffusion, which occurs mostly during the first stages. As the neck radius between two grains increases, grain growth dominates due to diffusion at grain interfaces, causing a boundary migration. Grain boundary diffusion reduces grain centre distances.
A 3D finite element software based on a mechanical approach, SALAMMBO, has been designed in our laboratory to simulate sintering. Each grain is modelled with a finite element mesh and is described as single crystal with an elastic constitutive law, all three diffusion paths included. A Lagrangian approach captures the irreversible shape evolution.
This model will study grain growth and morphology of two-grain systems and will later be extended to more complex configurations with more particles and unusual shapes. It will enable analysis of microstructural evolution for different compositions, such as undoped/doped UO2 or other compounds like U3O8; and the computation of sintering maps, relating grain size and relative density

Professional Status of the Speaker

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No

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