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# Thermo-mechanical and Atomistic Assessment of First Wall and Optics in non-protective chamber in Inertial Fusion Energy

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Different Inertial Fusion Energy (IFE) First Wall (FW) protections have been proposed in diverse conceptual designs that lead to very different irradiation conditions and macroscopic effects. A review is needed to understand their behavior. Some years ago a European proposal projected the possibility of non-protective FWs considering W and nano-tungsten. This work is describing in detail the behavior of a W and nano-tungsten first wall under pulsed irradiation conditions predicted for the different operational scenarios of that laser fusion project by using advanced engineering modeling tools. Starting with the calculations of the time-dependent pulsed radiation fluxes, assuming 3D geometrical configurations, we estimate the irradiation-induced evolution of first wall temperature as well as, the thermo-mechanical response of the material. Finally, we carry out crack propagation calculations. Results allow us to define operational windows and to identify the main limitations for operation. The atomistic effects of irradiation in the FW are the other key magnitude to determine available lifetime. The role of grain boundaries on the radiation-induced damage and light species behavior is studied both experimentally and computationally, also under pulsed conditions. Important differences are observed in the density of vacancies between nanostructured and coarse-grained samples as well as the preferential places for H accumulation concluding with the influence of temperature.
Optics damage is a great concern in IFE; a new full conceptual final focusing system based on silica transmission lenses for dry wall chambers was designed assuming pulsed conditions based on a temperature control system by using a heat transfer fluid. Optical response of composite materials containing metal nanoparticles was investigated and optimized. Highly concentrated silver colloidal nanoparticle solutions were produced thanks to fs laser ablation and it was demonstrated that such embedded plasmonic nanoparticles may be viable candidates to reduce damages produced on optics by swift heavy ions due to the change of their shape under irradiation.

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