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Alternative plasma facing material for nuclear fusion reactors

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The development of plasma facing materials (PFMs) able to withstand the harsh conditions (large thermal loads and radiation-induced damage) in reactors is one of the key parameters for nuclear fusion to upscale to commercial power plants both, in inertial confinement fusion (ICF) and in the magnetic confinement fusion (MCF) approaches.
The radiation environment that PFMs will face in nuclear fusion reactors operating in the two previously mentioned pathways will be distinct. These disparities will lead to different radiation-induced damage, mainly: fuzz formation in MCF and exfoliation and cracking in ICF.
In this contribution, we will discuss the radiation environment that PFMs will withstand under MCF and ICF, both in the indirect (ID) and direct (DD) drive approaches, especially focusing on the differences between them [1,2]. Subsequently, we will illustrate the peculiarities of the radiation-induced damage associated to the irradiation conditions. Then, we will discuss the need of developing superior radiation-resistant PFMs, alternative to coarse-grained W (CGW), paying special attention to the capabilities of nanostructured W. We will also talk about the need for validating and improving computer codes to interpret experimental results and to predict material behavior under those extreme conditions not achievable in experiments. Finally, we will show that, in comparison to CGW, 3D isolated W nanocolumns exhibit retardation in fuzz formation [3], a lower sputtering yield under Ar [4,5] and D [6] irradiation, as well as a flattening in their angular dependence [4].

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