Design of a core plasma and chamber wall for dry wall fast ignition ICF power plant

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Assuming 20 µm size He bubble, thermal conductivity at the depth 2 µm is reduced to 1/100. In this case, surface temperature is almost adiabatically increased to around 2700K.

Estimation of Blistering Effect
Adequate cooling channel path enables ~40% thermal efficiency with coolant temperature at the first wall outlet of 400°C (cf. CREST reactor in MFE).

The maximum temperature at the tungsten/FS interface is reduced (661°C → 543°C).

Effect of Cooling Temperature

Synergy effect of multiple particles irradiation (α-particle, ions and neutron)

Influence of flake (or powder?) of exfoliated tungsten on laser irradiation/pellet injection

Other Concerning

°C  °C

α
The design of a moderate size, fast ignition laser fusion reactor with a dry wall chamber has been examined. Simulation by using 1-D hydrocode ILESTA-1D, which is modified to simulate fast heating, indicates the possibility of a pellet design yielding $G=100$, $P_{\text{fus}}=40\text{MJ}$.

According to the 1-D thermal analysis, surface temperature increase is not a concern in case that $R=5.64\text{m}$ and repetition rate is 30 Hz.

Although mass loss of the first wall due to blistering cannot be neglected, it is possible to overcome this problem by adequate maintenance schemes or the use of highly-engineered materials.