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Study of a new high power spallation target concept

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The ESS spallation target will be operating at 5 MW proton beam power. As the 5 MJ/s proton beam power is concentrated in 2.86 ms long 14 Hz pulses, the instantaneous power during each pulse impinging on target reaches 125 MJ/s. This large pulsed power condition poses a challenge in designing a robust and reliable target without sacrificing much of the neutronic performances.

In this report, we present a new rotating tungsten target concept that can be easily adapted to helium cooled and water cooled options. The proposed target has a simple geometric configuration with well-defined flow patterns. Both the helium cooled and the water-cooled options are investigated.

The purpose of this study is to show the technical feasibility of the new target concept. For the analysis, a number of numerical simulations have been performed using the particle transport code FLUKA and the multiphysics continuum physics simulation code ANSYS.

In this report, the particle energy deposition in the target, the thermomechanical characteristics of the target under proton irradiation, the decay heat analyses for accidental scenarios and the estimation of exothermic heat generation due to target material oxidation at high temperatures have been studied. The results indicate that the presented target concept have a good chance to keep its structural integrity, both for operational and accidental cases.

Summary

In this report, we present a new rotating tungsten target concept that can be easily adapted to helium cooled and water cooled options. The proposed target has a simple geometric configuration with well-defined flow patterns. Both the helium cooled and the water-cooled options are investigated.

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