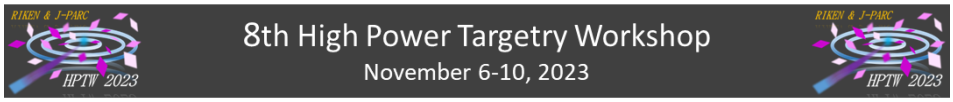

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Thermal hydraulic characteristics studies of upward spiral flow windowless target (UST)

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Accelerator driven subcritical system (ADS) is an attractive solution to nuclear wastes disposal. Spallation target is the key coupling component between accelerator and subcritical core in ADS, which plays very important role in adjusting the operation power of the overall system and maintaining security and stability. Liquid metal windowless spallation target is considered to have more potential advantages in thermal transport. The formation and regulation of free surface is crucial and challenging in windowless target, which affects the distribution of the internal flow field, and then constrains the heat transfer performances in beam-target coupling region.

A type of liquid metal windowless target based on upward spiral flow (referred to as upward spiral flow target, abbreviated as UST) has been investigated in our previous work [1]. UST employs a stationary impeller to generate upward spiral flow, which sprays outward under centrifugation and forms a free surface. By studying the regulation effects of UST structures on the distributions of flow field and stagnation zone below the free surface, two types of optimized targets (UST-A & UST-B) are finally established based on the preferred target structures and the corresponding structural parameters. Compared with the initial target, the optimal targets have smaller stagnation zone and better thermal transport performances. As shown in Fig.1(a) and Fig.1(b), UST-A has lower deposition heat power density and lower temperature rise than those of UST-B under the equivalent power level of the beam. As shown in Fig.1(a) and Fig1(c), UST-B has a lower temperature rise than UST-A under the equivalent density of the deposition heat power. The current research achievements have foundational signification for further engineering design and development.

References:
[1] Yang W F, Qiang C W, Wang F, Li L, Deng W P, and Zhang X Y. Three-dimensional CFD simulations to study the effect of impeller geometry on internal flow field in ADS upward spiral flow target[J]. Journal of Nuclear Science and Technology, 2018, 55(12): 1381-1392.

Themes for the contribution

1 R&D to support concepts

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