

Thermal Diffusivity Measurement of Functional & Structural Materials for Fusion Blanket Application

Friday 26 October 2018 08:30 (4 hours)

Evaluation of thermal profile inside breeding blanket is an important aspect for fusion reactor. Due to thermal neutron flux during steady state operation of future fusion reactor, breeder materials in the blanket will be at elevated temperature up to 900°C. However, during ITER pulse operation with 1800 s pulse length, the maximum estimated temperature is ~650°C. India specific Reduced Activation Ferritic Martensitic (IN-RAFMS) steel has been considered as the structural material and various functional materials such as lithium titanate (Li₂TiO₃) pebbles as the tritium breeder and molten lead-lithium (Pb-Li) eutectic alloy as coolant & tritium breeder have been identified. Li₂TiO₃ pebbles of 80-90% density will be kept inside the canisters made of IN-RAFMS. To analyze the thermal profile inside the breeding blanket, several simulations are being performed. Thermal properties as a function of temperature and density are the major parameter to perform these simulations. It is therefore necessary to evaluate the thermal diffusivity and thermal conductivity of Li₂TiO₃ material as a function of temperature and density. The thermal diffusivity of the IN-RAFMS is also measured as a function of temperature from room temperature to 800°C. In the present investigation it is observed that thermal diffusivity of lithium titanate is decreasing from ~0.013 cm²/s at RT to ~0.006 cm²/s at 800 C. However thermal diffusivity of IN-RAFMS is decreasing from ~0.08 cm²/s at RT to ~0.035 cm²/s at 700°C which further increase to ~0.045 cm²/s at 800°C. In the present studies lead lithium samples are also measured from room temperature to its eutectic temperature. Simultaneous measurement of thermal conductivity and specific heat capacity of Li₂TiO₃ pellet, IN-RAFMS and lead lithium are also discussed in this paper.

Country or International Organization

India

Paper Number

FIP/P7-22

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Session Classification: P7 Posters

Track Classification: FIP - Fusion Engineering, Integration and Power Plant Design