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

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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℃. However, during ITER pulse operation with 1800 s pulse length, the maximum estimated temperature is ~650℃. India specific Reduced Activation Ferritic Martensitic (IN-RAFM) 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℃. 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℃ which further increase to ~0.045 cm2/s at 800℃. 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.

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