ICFRM2007/311
Conception of operation of oxide insulating coating as applied to V\ Li blanket

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Development of insulating coating is a key to the viability of V\ Li blanket concept. Continuous production of in-situ insulator oxide layer at the "solid metal / liquid metal" interface is suitable at the inner wall of ducts. The reaction is to be sustained owing to the diffusion inflows of oxygen from the vanadium alloy and active metal (Er, Ca, Y) from the liquid lithium. The principle feasibility of in-situ formation of insulating coatings (Er\textsubscript{2}O\textsubscript{3}, CaO) at the interface was proved experimentally. However the conceptual view on the coating behaviour has not been elaborated yet. In this report the conceptual model of charging of V-4Ti-4Cr alloy by oxygen and deoxidation under the contact with Li [Er] melt is presented. The interaction of V-alloy with oxygen and lithium is considered from the viewpoint of coating operation at the interface. The in-situ oxide coating is considered as a synergetic object, which evolves: originates, growths, stabilizers and degrades. The coating behavior at the interface is controlled by the kinetics of physical-chemical processes in the solid metal which obey the laws of reactionary diffusion. The kinetics is determined by the phase composition and structure of V-alloy after charging by oxygen. The charging procedure is considered using the theory of low-temperature inner oxidation. The model of formation of inner oxidation zone is proposed. In the frame of the proposed model the temperature interval and partial pressure of oxygen in Ar\textsubscript{O\textsubscript{2}} during the oxidation are substantiated and the key role of vacuum annealing is underlined as well. The calculated data reflect adequately the oxygen distribution after oxidizing in Ar\textsubscript{O\textsubscript{2}} and vacuum annealing which were observed experimentally. The deoxidation of V-alloy during the contact with Li [Er] is considered as a diffusion process accompanied by the structure-phase transformation in the solid metal. The interaction of oxygen with erbium on the surface of the solid metal (coating formation) as well as its dissolution in the bulk of liquid lithium was taken into account. The effect of temperature on the coating longevity is considered in the context of proposed model.