Experimental study of voltage breakdown over flibe liquid surfaces for IFE applications

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The beryllium fluoride and lithium fluoride eutectic mixture denominated flibe has been proposed as main option for coolant, breeder and chamber protection material in several IFE power plant design and concept studies. They involve situations in which the molten salt liquid surface is exposed to a high, transient electric field generated by space charges (as for the Heavy-Ion Beam lines of HYLIFE-II) or currents (as in the Z-pinch power plant concept). Voltage breakdown is generally inhibited by a vacuum gap allowed by the low vapor pressure of flibe in equilibrium over the liquid surface.

This paper presents the results of the experimental work on voltage breakdown over a flibe liquid surface performed at UCLA. A stagnant pool of flibe is maintained in thermal equilibrium in a vacuum chamber. The pool is contained inside an electrically grounded nickel crucible that functions as the discharge anode when breakdown occurs. A transient electric field is generated by charging an electrode suspended over the pool surface up to 12 kV in less than 0.6 μs. Breakdown voltage is measured as a function of the electrode distance from the surface and the liquid temperature. The composition of the gas in equilibrium with the liquid surface is monitored with a residual gas analyzer. The effect of the impurities dissolved in the molten salt on voltage breakdown is discussed along with the relevance of the presented results for IFE applications.