# An Advanced Metallic Composite for Use in Lead Fast Reactors

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Liquid lead and lead-bismuth eutectic (LBE) have a variety of interesting nuclear applications including accelerator driven systems (ADS), spallation neutron sources, and lead fast reactors (LFR). The structural materials that will be used in all of these applications will be exposed to a highly corrosive liquid metal environment, high temperature, and radiation damage. One strategy for designing a material that can sufficiently withstand these challenges is to develop a composite. Previous work by our group showed the development of a bi-layer metallic composite with a thick structural layer of T91 ferritic/martensitic steel, with a corrosion-resistant layer of Fe-12Cr-2Si deposited by weld overlay onto LBE-facing surfaces [1]. In the present work, we will discuss the evolutionary development of this composite design, along several different tracks. First, alternative structural layers with better creep resistance will be explored, including advanced ferritic/martensitic steels, austenitic Ni-base alloys, and refractory alloys. The impetus for using an alternative structural layer is to achieve an operating temperature for the composite of 700$^{o}$C or greater. In this case, the operating temperature is limited by the creep properties of the structural layer. We will present several alternative alloys for the structural layer of the composite. Laboratory-scale samples of these evolutionary composite designs will be fabricated using diffusion bonding. Characterization and inter-diffusion analysis of the samples will be presented. The use of an interlayer to enhance bonding between the corrosion-resistant Fe-12Cr-2Si layer and the structural layer will be discussed and demonstrated. Finally, initial results of ion irradiation experiments will be presented, with the goal of determining the stability under irradiation of the interface between the layers of the composite.

*References*

[1] M.P. Short & R.G. Ballinger (2012) A Functionally Graded Composite for Service in High-Temperature Lead- and Lead-Bismuth–Cooled Nuclear Reactors—I: Design, Nuclear Technology, 177:3, 366-381, DOI: 10.13182/NT12-A13481