AFA-steels for Lead alloy cooled nuclear reactors – an overview of the European activities in the GEMMA project

Alfons Weisenburger*[a], Renate Fetzer[a], Annette Heinzel[a], Adrian Jianu[a], Hao Shi[a], Georg Müller[a], Peter Szakalos[b], Peter Dömstedt[b], Thomas Helander[c], Serena Bassini[d], Chiara Ciantelli[d], Angela Fiore[d], Rebeca Hernandez[e], Marta Serrano[e], Vasile Radu[f], Alexander Nitu[f], Ingrid Proriol Serre[g], Jean-Bernhard Vogt[g], Lukasz Kurpaska[h]

*[a]Karlsruhe Institute of Technology, Institute for Pulsed Power and Microwave Technology Hermann von Helmholtz Platz 1, 76344 Eggenstein Leopoldhafen, Germany
[b]KTH Royal Institute of Technology, Drottning Kristinas väg 51, 100 44, Stockholm, Sweden
[c]Kanthal AB, Box 502, 734 27, Hallstahammar, Sweden
[d]Italian National Agency for New Technologies, Energy and Sustainable Economic Development, C.R. ENEA Brasimone, Italy,
[e]CIEMAT, Avda de la Complutense 22, 28040 Madrid, Spain,
[f]Institute for Nuclear Research, Pitești, ,
[g]Univ. Lille, CNRS, INRAE, Centrale Lille, UMR 8207 - UMET - Unité Matériaux et Transformations, F-59000 Lille, France,
[h]Narodowe Centrum Badan Jadrowych (NCBJ), Swierk, Poland

Abstract

The development of AFA steels as potential structural material for lead alloy cooled nuclear reactors was initiated at KTH and KIT some years ago due to the observation of LME (liquid metal embrittlement) in lead alloys of ferritic steels. Two general concepts were followed by the two involved institution, a lean AFA with low Ni by KTH and a high alloyed AFA by KIT.

In the frame of the H2020 EU project GEMMA three generations of both AFA routes were tested to explore the most preferable compositions. Corrosion tests in Pb at temperatures up to 650°C showed the potential of the best compositions. Finally, some mechanical data by small punch test, SSRT Tests and nanoindendation showed the ductility of most of the tested alloys. First ion irradiation on selected alloys revealed no hardening effect for both AFA concepts.

The presentation will give an overview on the work performed and on the actual status of the research in Europe on AFA steels for lead alloy cooled nuclear reactors.