

August 13-14, 2018
Paris, FranceTrends in Green chem 2018, Volume: 4
DOI: 10.21767/2471-9889-C1-009

NOVEL ALTERNATIVES FOR HEAT-TRANSPORT FLUIDS AND FOR STRUCTURAL MATERIALS IN CONCENTRATED SOLAR POWER (CSP) SYSTEMS: PB-BI-X ALLOYS AND CR-AL-STEELS

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Hheavy liquid metals, such as lead and bismuth, have found an important application in energy storage and heat transport systems. Pb-Bi eutectic (LBE) is the main alternative to Pb as a heat transport fluid in Generation IV Fast breeder reactors and in CSP systems due to its thermal properties and low reactivity. However, LBE has proven to be harshly corrosive to structural elements at 800°C, whose temperature is desired in CSP for increasing the efficiency of the power cycle. The main challenge in heavy-metal-based CSP technologies is to find a proper optimization (minimization) of corrosion effects of LBE, and proper corrosion-resistive structural materials. Here we present the results of our study in which we theoretically analysed several candidate additives/elements (X) to Pb-Bi and experimentally evaluated the best two of Pb-Bi-X alloys: lead-bismuth-antimony and lead-bismuth-germanium. Three candidate structural materials, Cr-Al-steels, were exposed to liquid alloys in static corrosion tests at high temperatures, under oxygen-controlled conditions. Post-corrosion characterization of the tested Cr-Al-steels (by SEM, EDS, X-ray diffraction, X-ray photoelectron spectroscopy and Raman spectroscopy) enables a comparison of corrosion effects of Pb-Bi-X alloys and anti-corrosive properties of tested ferritic steels.

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