Solute Transfer Between Liquid Alloys Through Solid Electrolytes

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A potentially effective way to refine molten metals is to use solid electrolytes to selectively remove or add minor elements. It is envisioned that in a process situation a bath of molten metal can be electrochemically connected to a solid electrolyte and a minor element repository. Upon application of a current, the minor element can be driven through the electrolyte into the bath for alloying, or if the current was reversed, any minor element present in the bath will be transferred to the repository. The effectiveness of this process will depend on the various resistances affecting the transfer rate. These are discussed in this paper.

The process system was simulated by using an electrochemical cell consisting of a molten bath of tin doped with sodium, and a rotating disc electrode containing a repository of liquid sodium, with the conducting surface made of sodium β-alumina. In order to clarify the limiting rates of the process, the rotating disc electrode phenomena was investigated. Different experimental conditions such as temperature, rotational speed, potential sweep rate and sodium concentration in the tin were tested. Results and observations from these experiments will be presented. Under refining conditions ie the sodium is removed from the tin bath it was observed that the sodium transfer was limited by liquid side mass transfer. During alloying conditions, it was observed that there was a sudden decrease in current with increasing negative potential possibly indicating intermetallic compound formation on the disc surface.