

Investigation of the phase relations in Cu-Li-Sn and the binary constituent systems

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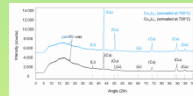
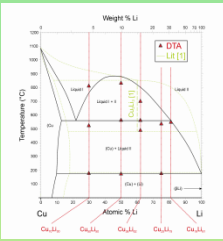
phase diagram calorimetry

Cu-Li:

- 5 samples produced from Cu and Li metal in Ta-crucibles
- Molten in induction furnace, 2 samples ($\text{Cu}_{70}\text{Li}_{30}$ / $\text{Cu}_{25}\text{Li}_{75}$) annealed at 700°C
- XRD (Guinier camera)
- DTA-DSC (Setaram Multi HTC)

Results:

- No evidence for intermetallic phase Cu_2Li_3 [1] found
- DTA and calorimetry results suggest a monotectic system
- Li easily diffuses through grain boundaries of Ta-crucible ($T > 500^\circ\text{C}$ / $t > 2-3$ days)

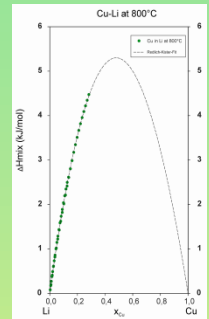


Cu-Li:

- Tian-Calvet Twin calorimeter with autosampler
- Mo-crucibles, Ar-atmosphere
- Drops of Cu in liquid Li (800°C)
- Drops of Cu in liquid Li at 1000°C was not possible (Li crept out of the crucible)

Results

- $\Delta_{\text{mix}} H^\circ$ of Cu in Li ~ 23 kJ/mol
- Redlich-Kister-Fit: ${}^0L = 21.165$, ${}^1L = -1.681$
- Maximum at $x_{\text{Cu}} \sim 0.5$ and $\Delta_{\text{mix}} H = 5.3$ kJ/mol

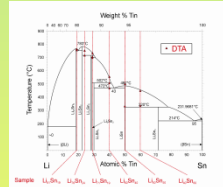


Li-Sn:

- 6 samples produced from Li and Sn metal in Ta crucibles
- Molten in resistance furnace, gentle rotation provides homogenous mixing
- Annealed at 300, 400 and 450°C
- XRD (Guinier camera)
- DTA-DSC (Setaram Multi HTC)

Results:

- Reaction temperatures and phase relations [2] could be confirmed
- Phase $\text{Li}_{22}\text{Sn}_5$ was refined as $\text{Li}_{17}\text{Sn}_4$; see [3]

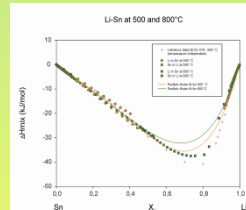


Li-Sn:

- BN crucibles for Li in Sn, Mo crucibles for Sn in Li
- $\Delta_{\text{mix}} H$ at 500 and 800°C

Results

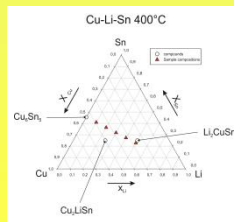
- 500°C**
 - $\Delta_{\text{mix}} H^\circ$ of Sn in Li ~ -175 kJ/mol
 - $\Delta_{\text{mix}} H^\circ$ of Li in Sn ~ -58 kJ/mol
- 800°C**
 - $\Delta_{\text{mix}} H^\circ$ of Sn in Li ~ -170 kJ/mol
 - $\Delta_{\text{mix}} H^\circ$ of Li in Sn ~ -59 kJ/mol



- Temperature dependence of $\Delta_{\text{mix}} H$?
- Minimum of $\Delta_{\text{mix}} H \sim -37$ kJ/mol (at $x_{\text{Li}} \sim 0.8$): Formation of associates of Li_2Sn can be assumed Li: e⁻-donor / Sn: e⁻-acceptor

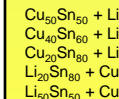
Outlook ternary Cu-Li-Sn:

- Cu_6Sn_5 alloy was produced in arc furnace
- Li + Cu_6Sn_5 -powder in Ta-crucibles
- Solubility of Li in Cu_6Sn_5 and phase relations at 400°C will be determined



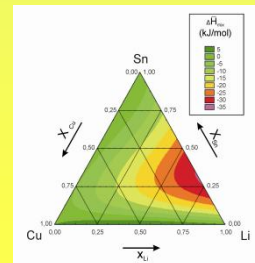
Cu-Li-Sn

- Cu-Sn binary data from [5]
- Isopleths at 800°C:



Results

- Redlich-Kister-Muggianu-model (800°C): ${}^1M = -395.986$, ${}^2M = -486.938$, ${}^3M = 141.153$



References

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