

Accepted Manuscript

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PII: S0167-7322(18)31288-1
DOI: doi:[10.1016/j.molliq.2018.04.020](https://doi.org/10.1016/j.molliq.2018.04.020)
Reference: MOLLIQ 8923
To appear in: *Journal of Molecular Liquids*
Received date: 14 March 2018
Revised date: 3 April 2018
Accepted date: 4 April 2018

Please cite this article as: S.C. Liu, J.C. Jie, J.J. Zhang, P.F. Wang, T.M. Wang, T.J. Li, G.M. Yin , A surface energy driven dissolution model for immiscible Cu-Fe alloy. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Molliq(2017), doi:[10.1016/j.molliq.2018.04.020](https://doi.org/10.1016/j.molliq.2018.04.020)

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A surface energy driven dissolution model for immiscible Cu-Fe alloyS.C. Liu ¹, J.C. Jie ^{1*}, J.J. Zhang ¹, P.F. Wang¹, T.M. Wang ¹, T.J. Li ², G.M. Yin ¹¹ Key Laboratory of Solidification Control and Digital Preparation Technology

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Abstract

Cu-Fe alloy processed by conventional preparation methods has serious large-scale composition segregation or spatial separation of individual Cu and Fe phases prior to solidification. For immiscible Cu-Fe alloy, a homogeneous melt is the prerequisite to obtain the subsequent uniform solidification microstructure. In this paper, the uniform metastable immiscible Cu_{100-x}Fe_x alloys (x=10, 20, 30, 40 wt.%) were prepared by arc-melting. The results indicated that with increasing melting times, the initial aggregated Fe-rich melt gradually dissolves into the bulk copper matrix and a homogeneous melt is obtained. Herein a thermodynamic model was constructed to discuss the surface energy driven melting process and the formation of uniform Cu-Fe alloy. During melting process, if the radius of detached liquid Fe-rich droplet is less than the calculated critical radius, the surface energy is high enough to compensate for the partial molar excess Gibbs energy of iron, thereby leading to the spontaneously dissolution of detached liquid Fe-rich droplet into the bulk liquid. As a result, the aggregated Fe-rich melt dissolves step by step eventually forming a homogeneous

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