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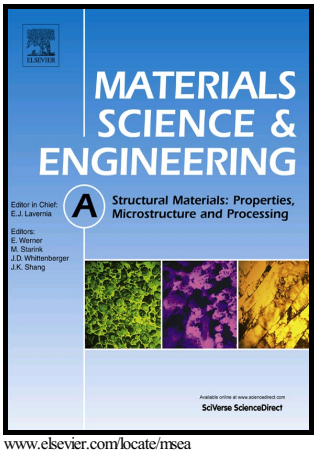

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Development of a new class of high strength copper alloy using immiscibility route in Cu-Fe-Si system: Evolution of hierarchical multi-scale microstructure

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Abstract:

In this paper, a new high strength copper based alloy (Cu-20at%Fe-5at% Si) in Cu-Fe-Si system is reported that is designed by accessing submerged liquid miscibility gap of the Cu-Fe system and ternary addition of Si for a hierarchical design of microstructure. The alloy was synthesized by suction casting of the melt into a copper mould. This paper further elucidates the sequence of evolution of metastable phases in the microstructure due to non-equilibrium solidification through detailed characterizations of the microstructure of the alloy using transmission electron microscopy. The microstructure containing particles with globular morphology of the Fe-rich DO_3 ordered phase suggests its origin in the liquid state consistent with the expectation of a metastable liquid immiscibility. The solute rejection process during the later stage of solidification and the solid state cooling results in the evolution of Fe rich nano sized fully coherent ordered particles in the Cu-rich matrix. This particular alloy has achieved an excellent mechanical strength both at room temperature and at elevated temperature. The correlations between microstructure and mechanical behavior have been discussed in details.