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Al-Ti熔体中C粉末的超声悬浮与TiC反应

李英龙1，曹富荣1，冯海阔2，陈彦博1

(1. 东北大学 材料与冶金学院，沈阳 110004；
2. 吉林大学 材料科学与工程学院，吉林130025)

摘 要：设计了一种电致伸缩式单轴超声悬浮反应系统，在Al-Ti熔体中形成超声驻波，使C粉末悬浮在合金熔体中进行TiC合成反应，以制备Al-3Ti-0.15C晶粒细化剂。通过组织观察和声压分析，研究了C粉末的悬浮情况、合金的组织形态及其形成机制。结果表明：只有在声辐射功率较小的时候，超声波在辐射块与反射板间的熔体中形成声压节点，在声压梯度作用下，使C和$TiAl_3$能稳定地悬浮在声压节点处，而声功率较大时，驻波的二次谐波增加，声压节点消失，C粉末的稳定性破坏；C粉末的反应过程为：超声的空化效应使$TiAl_3$溶解形成活性Ti，并通过Ti、C发生合成反应形成TiC相，同时，对TiC粒子具有热激活作用。

关键字： Al-Ti-C合金；晶粒细化剂；超声悬浮；反应机制

Ultrasonic levitation of C powder and TiC synthesis reaction in Al-Ti melt

LI Ying-long1, CAO Fu-rong1, FENG Hai-kuo2, CHEN Yan-bo1

(1. School of Materials and Metallurgy, Northeastern University,
Shenyang 110004, China;
2. School of Materials Science and Engineering, Northeastern University,
Jilin 130025, China)

Abstract: An electrostriction type uniaxial ultrasonic levitation reaction system was designed. Ultrasonic stationary wave is formed to suspend C powder in Al-Ti melt to perform TiC synthesis reaction and the Al-3Ti-0.15C grain refiner alloy was prepared. The suspension state of C powder, microstructural morphology and its formation mechanism of such alloy were investigated after microstructural observation and sound pressure analysis. The results show that only when the sound radiation power is small, the sound pressure node is formed between radiation block and reflection board by ultrasonic. Under the action of sound pressure gradient, C powder and TiAl3 can suspend stably in the sound pressure node. When sound power is large, the second harmonic of stationary increases, the sound pressure node disappears and the levitation

stability of C powder is destroyed. The reaction process of C powder is that ultrasonic cavitation effect makes $TiAl_3$ be dissolved to form active Ti, and TiC phase is formed through the synthesis reaction of Ti and C, meantime, such effect has thermal activation influence on TiC particles.

Key words: Al-Ti-C alloy; grain refiner; ultrasonic levitation; synthesis mechanism