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**摘要:** 熔模吸铸是一种经济的 $\gamma$ -TiAl基合金汽车排气阀成型方法, 但早期的吸铸气阀存在严重的气孔缺陷, 这种缺陷的产生与吸铸充型过程的合金液流动密切相关. 为了直接观察和测量 $\gamma$ -TiAl基合金汽车排气阀吸铸充型过程中合金液的形态和卷气现象, 采用水模拟实验模拟了3种充型压力控制方式, 两种壳型组合形式下气阀吸铸充型过程. 模拟结果表明, 利用壳型顶部通气孔粗略控制充型压力的普通吸铸过程存在严重的卷气现象; 精确控制充型压力的“下进气法”和“上排气法”, 充型流动平稳, 充气流量 $<1.7 \text{ m}^3/\text{h}$ 或排气流量 $<1.5 \text{ m}^3/\text{h}$ 时, 充型流动无卷气现象. 进行了 $\gamma$ -TiAl基合金汽车排气阀吸铸实验, 实验结果与水模拟结果吻合. 应用吸铸充型运动学原理对上述现象进行了讨论.

**关键词:**  $\gamma$ -TiAl基合金, 汽车排气阀, 吸铸, 水模拟WATER MODELING OF MOULD FILLING DURING SUCTION CASTING PROCESS OF AUTOMOTIVE EXHAUST VALVES OF  $\gamma$ -TiAl BASED ALLOYS

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**Abstract:** Investment and suction casting represents a more cost effective route to produce automotive exhaust valves of  $\gamma$ -TiAl based alloys, but the castings have severe gas porosities in the preliminary suction casting. It has been conferred that the generation of the porosity defects in the castings is a result directly associated with the entrapped air during filling flow. In order to investigate the filling patterns and the entrapped air during the suction casting process of automotive exhaust valves of  $\gamma$ -TiAl based alloys, water modeling experiments have been done. The effect of three types of filling pressure control methods and two types of moulds on the filling patterns are systematically investigated in this paper. Results show that serious entrapped air occur during the filling flow with an rough pressure control method by means of the vents at the top of the moulds (called a general suction casting); Tranquil filling patterns are obtained under an accurate pressure control method (“gas charging” or “air leakage”), and if the gas charging flow is smaller than  $1.7 \text{ m}^3/\text{h}$  or the air leakage flow is smaller than  $1.5 \text{ m}^3/\text{h}$ , the entrapped air phenomenon disappear. Meanwhile, the general and the “air leakage” suction casting of TiAl automotive exhaust valves are implemented using the conclusions of the corresponding water modeling experiments, and the real casting results claim good qualitative agreement with that of the water modeling experiments. Finally, The reasonable explanation for the aforementioned results of the water modeling experiments is given using the filling kinetic principle of suction casting.

**Keywords:** gamma titanium aluminides automotive exhaust valves suction casting water modeling

收稿日期 2011-06-07 修回日期 2011-08-31 网络版发布日期 2011-12-16

DOI: 10.3724/SP.J.1037.2011.00354

基金项目:

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