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Optical investigation of the behaviour of the electric arc and the metal transfer during vacuum remelting of a Ti alloy

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Abstract

High-speed camera imaging and optical emission spectroscopy have been used for investigating the structure of the electric arc and the transfer mechanisms of the liquid metal during Vacuum Arc Remelting (VAR) of Ti alloys. The arc exhibited a similar operating regime to that described in the previous literature for the case of Inconel 718 and zirconium alloy electrodes. The arc behaved in a diffuse mode with many separate and rapidly moving cathode spots. Several parameters of the cathode spots, including their current, size and apparent velocity were evaluated. The application of an external axial magnetic field tended to encourage the cathode spots to locate themselves on the base of the electrode. A large density ratio of Ti^+ ions and Ti atoms in the interelectrode plasma was evaluated, suggesting that the plasma was strongly ionized. The calculated excitation temperature of Ti^+ ions (1 to 1.2 eV) was about 1.5 to 2 times greater than that obtained for Ti atoms. The transfer mechanisms of the drops of liquid metal might be classified into three main modes depending on the gap length: drop falling, drip short and drop erosion induced by the cathode spots. The importance of the influence of the arc on the metal transfer mechanisms was inversely related to the gap length.

Keywords: vacuum arc remelting, titanium, experimental study, electric arc, metal transfer

1. Introduction

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