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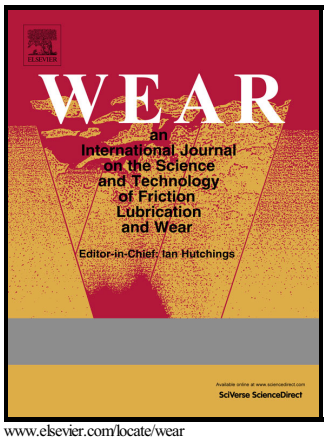

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Sliding Wear Behaviour of a Cr-base Alloy after Microstructure Alterations Induced by Friction Surfacing

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Abstract

Friction surfacing is a method suitable to generate a wide variety of metallic coatings by means of frictional heating and severe shear deformation. It is a solid-state joining method, and therefore may be applied to non-fusion weldable as well as non-deformable brittle materials, as Cr-based alloys are. In the present study coatings of Cr60Ni40 alloy are generated onto Nimonic 80A substrates. Microstructural investigations of the coating material are carried out and compared to the usual cast state. The wear behaviour of the coatings as well as the cast material is examined under reciprocating sliding against 52100 ball bearing steel by means of a ball-on-flat test rig, lubricated with silicone oil to prevent oxidation. In this tribological system, wear takes place by abrasion with microploughing being the predominant submechanism, surface fatigue as well as adhesion by materials transfer of Cr60Ni40 from the flats to the steel balls. White etching layers form on Cr60Ni40 underneath the worn surfaces, which show cracks and delaminations. The amount of wear of all coatings is within the same magnitude compared to the cast state but slightly smaller. This can be explained by the distinctly finer microstructure (grain boundary strengthening) and a high degree of supersaturation of the solid solutions (solid solution strengthening) within the coatings. The results of this study show that it is possible to generate coatings of brittle alloys like Cr60Ni40 by friction surfacing, which show a slightly better wear behaviour under reciprocating sliding. Thus, in combination with a ductile substrate, these coatings are likely to extend the range of applicability of such high-temperature wear and corrosion resistant alloys.

Keywords: solid-state joining, hardfacing, thermomechanical processing, non-ferrous metals, sliding wear

1. Introduction

Friction surfacing is a solid-state joining method, in which the required heat is generated by friction and the bonding is achieved under the applied forging pressure. A rotating rod made from the coating material is pressed with a defined axial force onto the substrate, and the friction in the contact causes heating of both rod and substrate material. When the heat flow into the system and the surroundings is adequate, the temperature maximum is located within the rod tip, and the acting frictional torque causes the thermally softened material to flow. Now, the relative

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