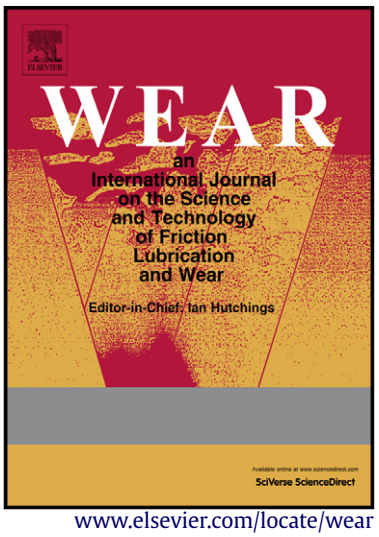

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N. Fois, J. Stringer, M.B. Marshall

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Adhesive transfer in Aero-Engine Abradable linings contact

N. Fois, J. Stringer, M.B. Marshall

Department of Mechanical Engineering , The University of Sheffield, Mappin Street, Sheffield, S1 3JD, UK

Abstract

Wear of abradable linings has been investigated on a scaled test rig platform, re-creating the wear mechanisms observed between the blade tip and abradable material that occur in an aero-engine compressor. The characterisation of the wear process has been performed using a stroboscopic imaging technique, capable of investigating the nature of the blade tip strike on the abradable, and the adhesive transfer of the material to the blade tip during a test. It was found in tests with low incursion rates that there was adhesive transfer, whereas with high incursion rates a cutting behaviour was observed. Analysis with the stroboscopic imaging technique allowed the adhesive transfer during the test as a function of the rub length to be recorded. Three phases were identified for adhesive transfer during test; an initiation phase with low rate of adhesion, steady state adhesion, and fracture of adhered material followed by re-initiation. These results also highlight how the standard practice of performing analysis of adhered material at the end of a test does not necessarily characterise the overall mechanics of adhesive transfer satisfactorily.

Keyword : Abradable, Adhesion, Abradibility, Aerospace

1. Introduction

Abradable linings [1,2,3,4] are composite materials used within aero-engines characterised by good abradability and erosion resistance. These materials [5,6,7] have been used as a lining for casing walls in aero-engines for about the last 40 years. Abradable linings allow tip clearances between the rotating blades and casing wall to be minimised [5]. This helps to achieve improvements in efficiency when the jet engine is working, as well as a minimisation in fuel consumption. During engine operation the rotating blades may strike the wall of the surrounding casing. If this occurs without an abradable material present, the blade tips will wear [8,9] and the overall clearance will increase, producing a loss in efficiency of either the compressor or turbine. This occurs as air leaks over the aerofoil tip, with a consequent energy loss from the flow. Should an abradable be used on the casing wall, this will wear in preference to the blade, resulting in only a local clearance increase. Therefore with an abradable material present, the total efficiency will not be significantly reduced,