Chapter 2
Tribocorrosion of Thermal Sprayed Coatings

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ABSTRACT

Triboelectrochemical response is concerned with different electrochemical-controlled wear experiments designed to understand tribocorrosion behaviour of materials and coatings. Tribocorrosion is defined as material degradation resulting from simultaneous action of wear and corrosion and it is found in many engineering applications, but the involved mechanisms are still only partially understood. In this chapter, a brief overview of tribocorrosion testing techniques is followed by issues which have helped us in gaining in-depth scientific knowledge of tribocorrosion. The overview is further substantiated by detailed studies and observations on tribocorrosion of thermal sprayed coatings in recent times.

1.0 INTRODUCTION

Tribocorrosion is a form of material degradation or transformation which results from synergistic effect of sliding wear and corrosion. The interaction of wear and corrosion is complex. The extensive knowledge of wear of materials in the absence of corrosive fluid and that of the corrosion of materials in absence of wear does not

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suffice to predict the nature of degradation under condition of tribocorrosion. It is true that wear influences the sensitivity of material to corrosion. At the same time corrosion does govern the conditions of friction. There is synergy between wear and corrosion. The interaction between corrosion and wear often results in substantial enhancement of material loss. More often than not this material loss is much higher than the sum of the individual contribution of wear and corrosion. A large number of engineering components are subjected to tribocorrosion such as mining equipment, food processing devices, biomedical implants, chemo-mechanical polishing etc.

Thermal spraying has been increasingly used for wear resistance application for the last few decades (Stein et al., 1999; Barbezat & Nicoll, 1993; Spear, 1989; Chen et al., 2005). With this process, the coating material, in powder form or wire, is fed into the combustion chamber of a gun where, a fuel, such as hydrogen, ethylene or kerosene etc, is burned with oxygen, and the heated and softened materials are expelled as a spray with the high speed fluid. Thermal spraying is one of the most versatile techniques for depositing wear resistant materials. It allows rapid and efficient ways of depositing variety of materials on different substrates. It is a fast, easy to apply and efficient way of depositing coating materials. It has the ability to deposit coatings with thicknesses ranging from several micrometers to tens of millimetres. Additionally, it is suitable for a great variety of shapes and sizes and had the advantage of maintaining the substrate temperature relatively low. There are a lot of techniques to melt and propel the coating material. However, to achieve optimal performances, various coatings need to be evaluated separately for individual cases.

Over the years, significant work is done on tribocorrosion as evident from several reviews (Landolt et al., 2001; Wood, 2006). The triboelectrochemical techniques were applied on a variety of sliding contact conditions, varying from unidirectional motion (pin on disk), reciprocating motion contacts, fretting or spinning contacts. The most investigated materials were model alloys for fundamental mechanisms identification (Mischler et al., 1998; More et al., 2011; Stack & Chi, 2003), followed by biomedical alloys (Vieria et al., 2006; Barradja et al., 2006; Diomidis et al., 2011), seals materials (Serre et al., 2002), materials for nuclear reactors (Benea et al., 2004) and chemo-mechanical polishing (Bielmann et al., 2000). Interestingly, all these materials were passive alloys even though passive materials may significantly degrade under the combined action of corrosion and wear when the passive layer is destroyed mechanically. The work on tribocorrosion on coatings is very much limited (Shenhar et al., 2000; Galliano et al., 2001; Vieria et al., 2006) and among these a few work is done for thermal sprayed coatings.

This presentation therefore begins with a brief overview of tribocorrosion testing techniques published in recent literature following introduction. After describing the tribocorrosion test techniques, background and issues which have helped us in gaining in-depth scientific knowledge of tribocorrosion has been discussed. The overview
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