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Mechanical and Tribological Properties of Crystalline Aluminum Nitride Coatings deposited on Stainless Steel by Magnetron Sputtering

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Abstract

Aluminum nitride (AlN) coating is a potential candidate for addressing the problems of MHD pressure drop, tritium permeation and liquid metal corrosion of the test blanket module of fusion reactor. In this work, AlN coatings were grown on stainless steel by magnetron sputtering. Grazing incidence X-ray diffraction measurement revealed that formation of mixed phase (wurtzite and rock salt) AlN was favoured at low discharge power and substrate negative biasing. However, at sufficiently high discharge power and substrate bias, (100) oriented wurtzite AlN was obtained. Secondary ion mass spectroscopy showed presence of oxygen in the coatings. The highest value of hardness and Young's modulus were 14.1 GPa and 215 GPa, respectively. Scratch test showed adhesive failure at a load of about 20 N. Wear test showed improved wear resistance of the coatings obtained at higher substrate bias.

***Keywords**: aluminum nitride; wurtzite; magnetron sputtering; adhesion; hardness; wear.*

1. Introduction

Reduced activation ferritic/martensitic (RAFM) steel and vanadium alloys have been accepted as the candidate structural material for various types of solid and liquid based tritium breeding blanket design concepts, proposed by the participating countries in International Thermonuclear Experimental Reactor (ITER) programme. Accordingly, it has seen the