CHAPTER I

INTRODUCTION

Transition metal nitride coatings become interesting because of their outstanding mechanical and tribological properties: high hardness (20-25 GPa, approximately), good adhesion to metal substrate, good corrosion and wear resistance [1]. Chromium nitride (Cr_xN) material is one of the transition metal nitride that has become an interesting material in recent year. Because it has high hardness [2], wear, corrosion [3], high temperature oxidation resistance even at 700 °C [4] and low friction coefficient [5]. In addition, chromium nitride is a ceramic-liked film and almost chemically inert. So, it has highly corrosive resistance in various environments [6]. Moreover, it is also a biocompatible material that can be used in the biomedical applications [7]. All these properties make chromium nitride thin films improve the lifetime of materials and be widely used in many applications such as corrosion and wear protection in tools especially soft substrates such as plastic [8] die casting molds [9], automotive parts and decorative materials [10].

Another reason of interesting in chromium nitride thin films is that chromium nitride deposited by physical vapor deposition process (PVD) replaces hard chrome in electrochemical process for hard coating purpose. This electrochemical process produces harmful hard chrome into the environment [11]. In addition, the hardness of chromium nitride has higher than that of hard chrome. The hardness of chromium nitride is between 1700 and 2400 HV over the composition range from $CrN_{0.1}$ to stoichiometric CrN [12]. In contrast, the hardness of hard chrome is between 600 and 1200 HV [12].

Independent deposition techniques, the partial pressure of reactive nitrogen gas influence different structures: Cr, Cr + N, Cr_2N, Cr_2N + CrN and CrN structure [10, 13, 14]. To gain the single CrN films, the highly partial pressure of nitrogen is needed. The hardness of chromium nitride thin films depends on the nitrogen content and crystalline structure of Cr_xN films [2]. The structure and orientation of crystals in the films can influence friction properties [15]. In case of nitride films, it has been reported that main parameters controlling the film microstructure are the deposition temperature, partial pressure of nitrogen and bias voltage [16]. These parameters also influence tribological, mechanical and chemical properties of the films [13].

Chromium nitride thin films can be produced by several PVD techniques such as arc deposition, ion plating and reactive sputtering methods. In this work, the reactive magnetron sputtering technique is used. However, there is little information about the growth parameters of chromium nitride thin films for some specific applications such as aluminum and treated irons. The deposition temperature of these substrates needs be lower than 250 °C [9]. The aim of this work is to control the growth parameters in Cr_xN thin film, which are grown at low growth temperature at optimized condition controlling the properties of chromium nitride thin films.

This thesis is divided into five chapters. In the following chapter, chapter 2, theoretical background of d.c. reactive magnetron sputtering technique is described. In chapter 3, characterizations of thin film in structural and tribological properties are described. Chapter 4 describes experimental results and discussions. The final chapter of this thesis, chapter 5, is conclusions.