PREDICTION OF TiN FILM COATING CHARACTERISTICS USING FUZZY LOGIC TECHNIQUES

NUR ATHIRAH BINTI KADIR

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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PREDICTION OF TiN FILM COATING CHARACTERISTICS USING FUZZY LOGIC TECHNIQUES

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This report is submitted in partial fulfillment of the requirements for the
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DEDICATION

I would like to write down my dedication especially to my beloved parent and sister;
Kadir bin Awang and Nor Hasni binti Kadir
siblings and friends,

Thank you for encouraged, prayers that never end guided and inspired me both during my education journey and also to finishing my.

Lastly, I would like to thanks to my beloved supervisor that have guided and passionated me while completing this PSM.

May Allah pay all your kindness.

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Thank you.

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ABSTRACT

High competitiveness in today's industry is determined by high quality, low price and first to market products. In early 1980s, the Titanium Nitride (TiN) was the first commercialized PVD coating material. The original application for this metal was in the military aerospace industry specifically because of its efficiencies in structural qualities, a result of titanium's strength and density. This study is about the prediction of the surface cutting quality by identifying using the fuzzy techniques approach. There are coating process parameters that will be included in this study which are Nitrogen (N2) pressure, Argon pressure and turntable speed. Bell shape and triangular membership functions were proposed in developing the fuzzy rule-based model. Result of the fuzzy rule-based model was validated using residual error and prediction accuracy. The fuzzy rule based model with generalized bell membership function showed less residual error and higher prediction accuracy with 4.48% and 95.52% respectively. The result showed that the fuzzy logic could be a good alternative approach in predicting TiN coatings.

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ABSTRAK

Persaingan sengit dalam industri ditentukan oleh kualiti yang tinggi, harga rendah dan siapa yang mula memasarkan produk. Pada awal 1980-an, 'titanium nitride' merupakan saduran PVD yang pertama dikomersialkan. Aplikasi asal untuk logam ini ialah industri ketenteraan aeroangkasa disebabkan oleh keberkesanannya dalam struktur, hasil daripada kekuatan dan ketumpatan titanium. Kajian ini mengenai ramalan kualiti permukaan pemotong dengan menggunakan teknik kabur. Terdapat parameter proses yang disadur yang akan digunakan dalam kajian ini ialah tekanan nitrogen, tekanan argon dan kelajuan pemain piring hitam. Model kabur akan menggunakan fungsi keahlian segi tiga dan fungsi keahlian loceng umum. Keputusan logik kabur ini akan dikenal pasti menggunakan ralat sisa dan ketepatan ramalan model tersebut. Model logic kabur dengan menggunakan fungsi keahlian loceng umum menunjukkan ralat sisa yang sedikit dan ketepatan ramalan yang tinggi dengan 4.48% dan 95.52% secara tak langsung. Keputusan itu menunjukkkan bahawa logik kabur adalah berkesan dalam mengkaji TiN yang disadur.

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LIST OF ABBREVIATIONS

PA	-	Prediction Accuracy
PVD	-	Physical Vapor Deposition
RE	-	Residual Error
RMSE	-	Root Mean Square Error
TiN	-	Titanium Aluminum Nitrite

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CHAPTER I

INTRODUCTION

1.1 Project Background

In this study, an approach to predict the surface of cutting quality has been identified by using the fuzzy techniques. Today's industry is seeking for the best machine that can produce high quality of the cutting machine. Furthermore, this cutting machine is an advanced thermal cutting process of complex nature. Thin film coating is the thin layer of materials that are used to develop filters, increase insulation or conduction, protect them from lights or create reflective surfaces. Therefore by applying thin film coating on cutting tool the performance of the cutting tool will be increase and have the improvement (Jaya 2013).

Thin film coating play a prominent role on the manufacture of many electric devices. Most common types of thin film coating method are Physical Vapor Deposition

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(PVD). Using this titanium nitride (TiN) because it was the hardest metal that exists which is the hardness of the titanium nitride (TiN) is 2900HV. This paper aim to use fuzzy logic as the technique to estimate the best output because of this model is best fits in predicting the experimental values to the closest proximity and by using fuzzy logic approach, the efforts of an expert to find the particular output result can be eliminated (Syna, Mokhtara et al. 2011).

Furthermore, this fuzzy logic method has been a major method to apply in the problems such as the complexity and also need to deal with the uncertainty. In order to estimate the best output, the parameter or the characteristic to estimate it have been produced. The characteristic consist of surface roughness, grain size and thickness of the coating for Titanium Nitride (TiN). Therefore, in order to obtain machining process effectively, efficiently and economically, proper selection of cutting tool materials is important. Recently, with the development of coated cutting tool materials, it is possible now to machine at higher cutting speed thus improves productivity. Machining is one the major operation in manufacturing process in an industry to get finished goods. The quality of product is depends on the surface finish.

To achieve optimum surface roughness with the constraint cost, time and available facility, the variables affecting surface finish need to studied. The machining variable speed, feed and depth of cut are the most influential machining parameters in milling operation. The other variables such as work piece material properties, tool wear, vibration, cutting fluid properties, are also affecting the surface finish but this will not be covered in this research. The machining with end milling process is one the most widely used manufacturing process in an industry. It is also observed that conventional and advanced techniques and intelligent techniques are used for predicting the surface roughness. The results indicate that the fuzzy logic modeling technique can be effectively used for the prediction of surface roughness, grain size and thickness of coating (Purushottam S. Desalea, 2013).

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1.2 Problem Statement

In order to fulfill the requirement for the machining process by using the coated cutting tool, the effective model is needed to be developed in order to cater the problems of manufacturing cost in PVD coating process and the needed of characteristic for coated tool that suitable with difference machining application.

1.3 Objective

i. To identify the optimum fuzzy logic parameter that influence the prediction performance
ii. To develop fuzzy logic model in predicting coating characteristics based on optimized fuzzy parameter
iii. To evaluate the performance of proposed fuzzy logic model using confirmatory test data

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1.4 Scope

The scopes of this study are as follows:

i. Techniques and best parameter that will be used to predict coating characteristics.
ii. Characteristics that are being considered in this study are surface roughness, grain size and coating thickness.
iii. Fuzzy rule based is used to expect the output response.

1.5 Project Significance

Based on this study, the expected output that will be come out is the optimum of the characteristic that will be achieved then it will be solve the problem of the finding the best characteristic of the coating for the manufacturing industry. Then, this study also will be helpful in the cost management of the manufacturing industry because this thin film coating will be produce best of coat cutting tool which will be the save for the cost because this cutting tool life time will be much longer than uncoated cutting tool.

Based on the educational, this study can help the student to get the latest information about this coating characteristic and the use of the fuzzy rule model in this study in order to get the best result for the characteristic of coating. Furthermore, this study can give more about how the fuzzy approach can handle this real world problem especially in complex and imprecise system in the science and engineering field. Besides that this significance of the study will contribute also for the technology. Best coated characteristic have been found so, it will increase the technology in the manufacturing

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