RECIPE GENERATION OF UNDER FILL PROCESS BASED ON IMPROVED KERNEL REGRESSION AND PARTICLE SWARM OPTIMIZATION

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To my beloved wife, daughter, parents and friends.

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By the name of Allah Most Merciful and Gracious,

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ABSTRACT

The under fill process is a process that fills the gap between a chipset and a substrate using an epoxy material. The output of this process is a length of tongue that has to be controlled so it avoid touching the keep out zone. A recipe generation of the input parameters in the under fill process will help the length of tongue generated from touching the keep out zone. This project proposes a predictive modeling algorithm called Improved Kernel Regression and Particle Swarm Optimization in order to find the six input parameters needed in the under fill process. Even though only few samples of the under fill data sets are used in the simulation experiment, the proposed approach is able to provide a recipe generation of the six input parameters.

ABSTRAK

Proses *under fill* adalah proses memenuhi ruang di antara peranti elektronik dan substrat dengan menggunakan bahan *epoxy*. Keluaran daripada proses ini adalah saiz *tongue* yang perlu dikawal supaya ianya tidak menyentuh zon larangan. Generasi resipi parameter masukan di dalam proses *under fill* dapat mengawal penghasilan saiz *tongue* daripada menyentuh zon larangan. Projek ini mencadangkan suatu model algoritma ramalan yang diberi nama *Improved Kernel Regression* dan *Particle Swarm Optimization* yang dapat mencari enam parameter masukan yang diperlukan di dalam proses *under fill*. Walaupun hanya beberapa sampel data *under fill* digunakan semasa ujikaji simulasi, pendekatan yang dicadangkan dapat menyediakan generasi resipi enam parameter masukan.

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LIST OF ABBREVIATIONS

IBM	-	International Business Machine
C4	-	Controlled Collapse Chip Connection
LCD	-	Liquid Crystal Display
MATLAB	-	Matrix Laboratory
PSO	-	Particle Swarm Optimization

LIST OF SYMBOLS

ω	-	inertia weight
c_1	-	cognitive coefficient
c_2	-	social coefficient
r_1	-	random parameter
r_2	-	random parameter

CHAPTER 1

INTRODUCTION

1.0 Background

In the field of semiconductor industry, the fabrication process development of a chipset is one of the major processes that must be taken vitally. The chipset or also known as flip chip packaging technology was firstly introduced by IBM in the late 1960's and the flip chip is known as Controlled Collapse Chip Connection (C4) [1]. Flip chip technology has been utilized more than 40 years ago and today flip chips are widely used for mobile phones, disk drives, LCD displays, watches, and lots more.

The flip chip fabrication process involves several sequential steps: wafer bumping, attaching the bump die to the board or substrate and then completing the assembly with adhesive under fill [1]. This project will cover on the under fill process which is the last step from the fabrication process that is done in INTEL Malaysia.

The under fill is a step where an epoxy material being filled between a chipset and a substrate in an assembly process. Figure 1.1 shows the illustration of an under fill process in an assembly process.

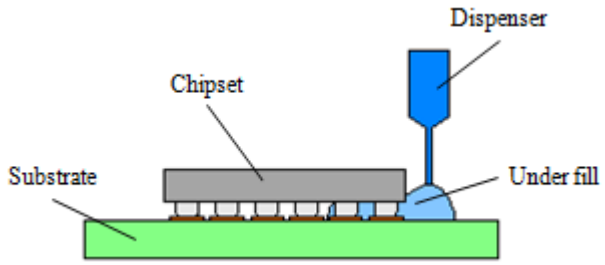

Figure 1.1: Illustration of an under fill process in an assembly process

As a result from this process, a tongue length is being produced due to the dispensed of epoxy between the chipset and the substrate. The tongue length is presented as the output of the process and it is actually being affected by six input parameters that need to be tuned. These six input parameters are consists of: chipset size (dimension of chipset), gap height, the number of bumps, the dispense distance and dispense weight (amount of epoxy) [2]. These six input parameters will be represented as the recipes needed or the generated recipes required in order producing the tongue length needed.

However, wrongly determined the six input parameters frequently can cause the epoxy to be excessive, the epoxy is on the chipset or the epoxy may insufficient. Figure 1.2 shows an example of a finishing of under fill process that produces an excessive length of tongue. The length of tongue generated must be taken care so that it avoids from touching the keep out zone. Figure 1.3 shows a result when the tongue touches the keep out zone. Thus, it is important for the engineers to have a recipe generation that gives key references for them to overcome the length of tongue from touching the keep out zone. In practice, the chosen ingredient of the recipes mainly depends on the engineer's knowledge and the experiment usually involves large samples and it involves high cost in setting up the experiments. This can often

result in insufficient data samples and by using the historical chipset data from an under fill process that consists of only a few samples, a simple prediction technique will be implemented in selecting the six input parameters.

Figure 1.2: Tongue length produce with excessive amount of epoxy

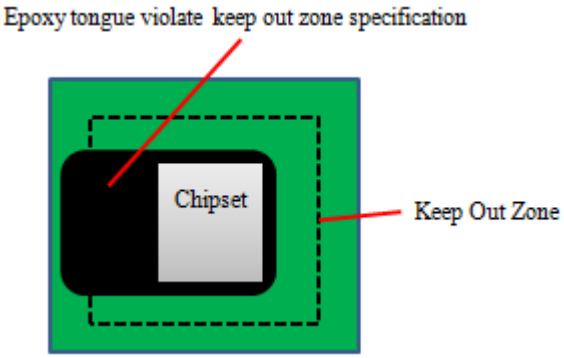

Figure 1.3: Epoxy tongue touch the keep out zone

1.1 Problem Statement

The experimental setup of the chipset is rather expensive in determining the best recipes that can avoid the length of tongue generated during the under fill process from touching the keep out zone. Thus, it is needed for the experiment to be cost effective. By using the historical data sets of under fill process from INTEL Malaysia, this project proposes an approach based on particle swarm optimization

and improved kernel regression for finding the best input parameters needed so that the length of tongue is in the area from keep out zone.

1.2 Project Objective

The objective of this project is to predict the recipes, which are the six input parameters needed in the under fill process using particle swarm optimization and improved kernel regression.

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