Research on the Common Causes of Defects and Their Prevention Measures for RCF-Type PCB Mills Production

Heying Wu, Haiyan Zhu

RESEARCH ON THE COMMON CAUSES OF DEFECTS AND THEIR PREVENTION MEASURES FOR RCF-TYPE PCB MILLS PRODUCTION

Heying Wu[11], Haiyan Zhu[2]

[12] School of Railway Tracks and Transportation, East China Jiaotong University, Nanchang, Jiangxi 330013, China
{Heying Wu, wuhy001}@163.com

Abstract. Blade-type error, edge collapse cutaway, micro missing, four kinds of defect for RCF-type PCB mill production are deeply analyzed and their preventions measures are given detailed according to the author's many year's practice. These measures have been practiced and achieved good results. The research results can increase pass rate of such tools in the production and reduce production costs obviously, and owns with a special important using values and widely promoted significance.

Keywords: PCB mills; Blade-type errors; Edge collapse; Missing angle; Micro missing

1 Introduction

Printed Circuit Board（PCB）is an important part of electronic component. PCB mills are used to process various products of printed circuit board for notebook computers and mobile phone plants. With the current rapid development of CNC machine tool technology, the production and the process technologies of PCB milling are also making progress. Through investigation, most domestic and foreign enterprises have adopted the high cost of CNC grinder to produce PCB milling. However, in spite of the performance of advanced CNC grinding machine, the production process of PCB mills will inevitably lead to a variety of defects because of its production technology, poor management and CNC machine tool comprehensive factors of failure and so on. In order to improve the rate of qualified products and reduce production costs, it is necessary to further study the causes of defects and effective measures of the PCB mills in its production process.

[1] Please note that the LNCS Editorial assumes that all authors have used the western naming convention, with given names preceding surnames. This determines the structure of the names in the running heads and the author index.

2 Type of PCB Mills

The following describes the common of four major categories PCB mills all over the world, they have accounted for above 90% of all the printed circuit board tools, and will have huge potential market and development prospects [1]. All the pictures in this paper are filmed by author himself during the production research process.

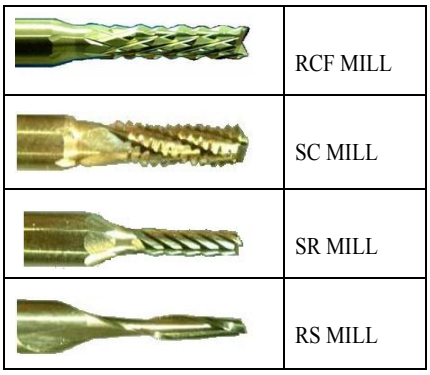

Fig. 1. Four types of PCB mills

2.1 RCF Mill (diamond mesh type mills)

This kind of mill is the most common type of cutting for milling printed circuit board outside, with diamond-shaped blade, chip up along the trench discharge, effective chip removal with a large cutting force and the characteristics of higher life expectancy. Its front-end tools will be designed to various structures and parameters according to the productive required, however, the shape of a swallowtail is the main designed structure to facilitate cutting materials.

2.2 SC Mill (spiral mills with broken bits slot)

SC Mill is called spiral mills with broken bits slot, its right spiral cutter blade as the main body, with multiple right-spiral grooves and the thin edge cutting edge grooves, and the spiral grooves with a good chip removal performance, especially suitable for processing of paper substrates and CEM-3 products.

2.3 SR Mill (consecutive mills with multi-edges)

SR Mill is called consecutive mills with multi-edges, has multi-right spiral cutting edges without chip-breaker grooves, which is mainly used for PCB terminal notch

processing. If the high accuracy is required, it can be designed to the right spiral and the left spiral types, which is mainly based on the process precision and the product categories.

2.4 RS Mill (consecutive milling with two edges under cut)

RS Mill is called consecutive milling with two edges under cut. This kind of mill has two left helical cutting edges and large junk slots, and suitable for precision milling. With excellent functions of machining surface precision and preventing flash. This under-cut mill is required to pay special attention to its downward chip removal direction.

3. Common Causes of Defect and Their Preventive Measures for Producing RCF-Type PCB Mills

In the above described the types of PCB mills, not only is the RCF-type milling cutter the most commonly used in processing printed circuit board, but also is the largest number of production in the enterprises. But the defects produced in the production process would decline the rate of finished products, which can lead to an increased production costs, and to market competition pressure of enterprises [2]. Therefore, it is necessary to further study and analysis the causes of defects and their preventive measures during the produce milling cutters in enterprises. The author has years' enterprise's production line experience of RCF type PCB milling. The following will analyze the common defect types, causes and preventive measures in the process of milling cutter production.

3.1 Defects 、 Causes and Measures of Blade-Type Errors

3.1.1 Blade-Type Errors

Blade-type error refers to the milling edge geometry and the geometric shape of drawings required exist one or several differences [3]. As shown in Figure 2 (a), the difference between the milling cutter and the drawing is that the former is less a L-edge, the drawings require RCF milling cutter has six Left- edges, but only has five Left-edges in the actual process of production, which must cause the milling cutter to waste product. Similarly, there exists such phenomena that the milling cutters are less one or several Right-edges, or while both on the left and right edges are less one or several edges in the milling cutters production, or vice versa. As shown in Figure 2 (b), the milling cutter has no fish tail, which would also cause it to waste product.

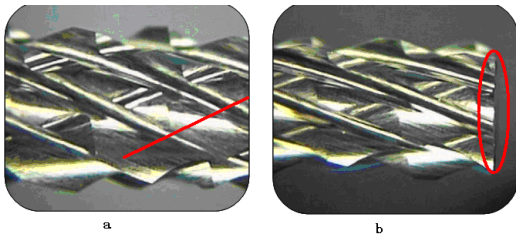

Fig. 2. Blade-type errors with (a) Less a left spiral edge and (b) Without fish tail

3.1.2 Causes of Blade-Type Errors

The main reasons for this defect are as follows: First, the operators are not strictly implemented the technological process of production, for example the technology workers look at drawings with mistakes cause to count the wrong edges, and then lead to set the wrong edges parameters of programs. Second, the machine operators have not checked the products, the milling cutters, carefully by themselves. Besides, the quality inspection workers have not timely feedback the defects to production sites, which lead a lot of such defect to occur. Finally, the technical personnel who did not perform their duties at the production site, they did not comply with the related requirements of production process, not strictly random in proportion to the production machine products, leading to these defects are ignored. However, the milling cutter has not the fish tail because of programmers forgot to compile the fish tail program, which causes CNC machine does not carry out the production process.

3.1.3 Preventive Measures

First, all the programmers, the technical personnel and the production operators must master the production drawings thoroughly and review them carefully, especially should rigorous review and check each parameter of the trial products. If there were parameters not comfort to the drawings, then the corresponding correction should to be done immediately, and eliminate such defects in the bud state effectively. Second, the machine operators and production technology workers should check the some proportion products made by machines randomly in accordance with of the production process. If any parameter surpasses the tolerance range, an immediate correction to the processing program parameter, to eliminate the edge flaws of products.

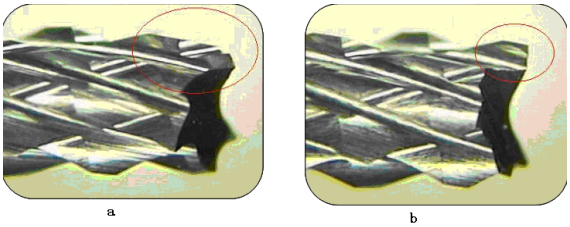

Fig. 3. Edge collapse with (a) Front end edge collapse and (b) Fish tail edge collapse

3.2 Edge Collapse

3.2.1 Causes of Edge Collapse

Edge collapse means a edge gap is greater than or equal to1/2 values of the edge depth or edge width, or the fish tail has the phenomena of serious damage and many edges missing.

Through analyzing, we know that the carbide is a common tool material, and its major shortcoming of mechanical property is brittle, if there is little impact or vibration, it would prone to cause the destruction phenomena of break off, flaking and collapse[4]. Therefore, the edge collapse defect is produced mainly by the following several reasons:

(1).Due to the unloading robot and the yard lumber holes beyond the tolerance range in the horizontal direction during the robots of CNC grinding unload mills to the yard lumber, resulting in a collision causes mills produce edge collapse defect.

(2).It is very easily leads to serious collision among mills, or with other objects while workers are taking, attiring or checking mills during all the production processes.

(3).The cutting grinding wheel edge has bumps lacks, which causes mills load uneven forces and thus produces edge collapse in machining the spiral grooves process.

(4).The grinding wheel surface is blocked by chips, which can increase friction force between the grinding wheel and the mills.

3.2.2 Preventive Measures

(1). Adjust the tolerance level accuracy between the unloading robot and the yard lumber holes in the horizontal movement direction to ensure that the both at work can not interference with each other.

(2).Mills can not be collided in all aspects of the production.

(3). In order to prevent collapse defect occurs in grinding wheel's edge, it is necessary regularly to test grinding wheel's working status and processing geometric parameters, which can ensure the wheel meets machining requirements.

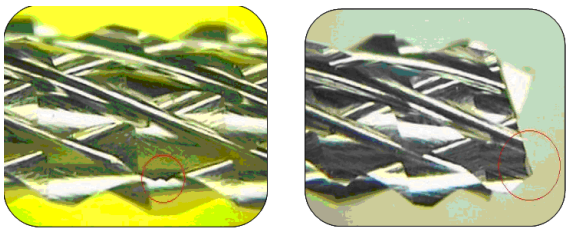

Fig. 4. Missing angle with (a) Middle edge missing angle and (b) Fish tail edge missing angle

3.3 Missing Angle

Missing angle means a edge gap is more than 1/4 and less than 1/2 values of the edge depth or edge width. The extent of this defect is much slither than the edge collapse defect. However, its causes are identical with the edge collapse. Therefore, its preventive measures are consistent with the edge collapse.

3.4 Micro Missing

Micro missing refers to a row of micro saw teeth are presented on edges. And it can be discovered by eyes observed carefully in compare with the edge collapse and the micro missing [5]. However, this defect is quite easy to be discovered if it is placed under the 20 or 30 times microscopes. So the defect judgment standards main rely on its appearance.

The main cause of micro missing is the surface of grinding wheel is too rough, resulting in a series of continuous micro saw teeth are generated on the milling edges by the grinding wheel's abrasives during the cutting process; another main cause is the initial speed of grinding wheel is too fast after finishing the wheel [6]. This defect can cause the result is that a serials of ripple type of cutting edges will present on products' surface, which can undoubtedly affect the quality of the PCB processing.

Preventive measures: First, The just repaired wheel should be slight grinded again by the whetstone wheel with micro size abrasives to further increase the grinding wheel surface's finish. Second, set the wheel with low-speed to grind in the beginning, and then gradually increase the speed to prevent the micro-missing of mill edges. Third, change the grinding wheel's rotation can reduce such defect according to certain rules in processing.

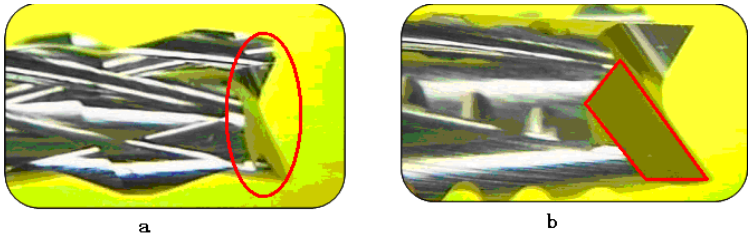

Fig. 5. Irregular fish tails with (a) Fish tail is asymmetry and (b) Moon surface arc

Fish tail is the most critical part to determine mill to process, and its geometric size and shape can directly affect the quality of PCB products and the life of itself. The judgment standards include the fish-tail's shape asymmetry and the moon surface arc and so on.

The main cause of this defect as follows: First, the aperture grinding wheel has not located in the fish-tail axis center while processing, which can make the fish-tail edge points exist a height difference and the geometry size is asymmetrical [7].

4 Conclusions

This paper at first introduced the most common types of PCB mills that produced by domestic and foreign enterprises. And then combined with the author's many years' front-line production practice learned in enterprise, in-depth study various definitions and types of defects of the RCF-type PCB mills, and shows with the corresponding defective photographs to explain the meaning of various defects clearly. Besides, this paper has also studied the common causes of each defect and proposed the practical and feasible preventive measures. These measures have been practiced and achieved good results, which has advantage of improving the rate of finished products and reducing productive costs, and owns with a very important applicable value and widely promoted significance.

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