

CURRENT STATE OF RESEARCH IN THE FIELD ON MICROMILLING

ЭТАП АКТУАЛЬНО ИССЛЕДОВАНИЯ В ОБЛАСТИ МИКРОФРЕЗЕРНАЯ

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Abstract: Part of microscale cutting, micromilling process is a relatively new area, intensive explored in the last 50 years and further, for miniaturization of engineering components. Without any exaggeration we can remark that the processing by micromilling is one of the most modern methods of manufacture because it gathers all the claims of accuracy and ultraaccuracy, layout, shape, etc. Therefore, considering the current needs and requirements of processing industry resulted from a thorough documentation prior to this work, we try to create a systematic approach to the current state in terms of micromilling process, area less known and discussed until now in our country.

Keywords: MICROMILLING, SYSTEMIC APPROACH, DEFINITION.

1. Introduction

Micro milling has been explored over the last 50 years in the pursuit of the miniaturization of engineering components.

The development of miniaturized technologies has become a global phenomenon with applications in diverse fields and industries including telecommunications, portable consumer electronics, defense, and biomedical. One technology used to create these miniaturized components is micro milling.

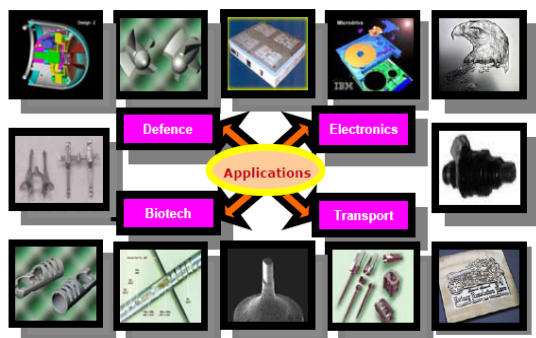


Fig. 1. Micromilling application [6]

The micromilling processing began to fill a place increasingly more important in the great family of machine manufacturing because of performances obtained among the processes, such as: manufacturing in preselected areas of the material being cut without suffering any deformation because the energy transfer is done locally and not in whole mass of material; manufacturing of any type of material no matter how hard it would be; the manufactures are resistant, precise and not always require later operations.

Micromilling aheads the common technologies by technical possibilities for processing various materials, including reactive and refractory materials. First of all the micromilling process separates from other conventional processes because of high quality of the surface layer and by obtaining a high accuracy of surface.

Without any exaggeration we can affirm that the micromilling process by microcutting was designed in order to eliminate deficiencies arising from common mechanical processing.

The investigations in micromilling area have established that it represents an attractive alternative for the manufacture of microparts due to the inherent flexibility of the process.

From bibliographic study regarding current state of micromilling processes have resulted that the process in our country is too little known and researched. Therefore, considering the current needs and requirements of manufacturing industry resulted from a thorough documentation prior to this work, we have directed the future doctoral thesis on the micromilling process, area very little approached until now.

2. Considerations on the name and definition process

Consulting the extensive bibliographies which we were able to access, we didn't find a clear and brief definition of micromilling process. However, depending on the materials consulted in different languages, micromilling is seen as a direct manufacturing operation of small parts, with surface shapes as surfaces network, offering an alternative to other manufacturing process.

Micromilling represents a reduce version of conventional milling, one of the most important and common cutting processes, with different features, depending on the researchers and the country which study the process.

It doesn't exist a major difference between terms regarding the name, distinguishing only by pronunciation which depends on the language used, the term keeping the prefix "micro".

Table 1. Features of micromilling in international literature

Literature	Tool diam [mm]	Spindle rotation speed [rot/min]	Feed rate [mm/min]	Ra [μm]	Precis. [mm]	Toler. [μm]
anglo-american	≤0.1	20000-150000	120-240	0.2	≤0.05	-
franch	≤0.1	100000-150000	200	0.2	0.01	0.05
Italian	≤0.2	120000	-	0.05	0.01	0.1

In Aglo-American literature (and implicitly the authors of Japan and China using English) "micomilling" is used, in French literature it's commonly used the term "microfraisage", "microfresatura" is used in Italian, "микроФрезерная" is used in Russian as a direct adaptation of the word in French and Italian, and "microfräsen" in German language. Therefore, considering that the dictionary designates for the word "micro": "small", "microscopic", "a million part of", during this work will adopt the name "micromilling".

3. Schools, companies, authors with notable achievements in micromilling area

Worldwide prestigious schools have made extensive investigations in micromilling area, the problem of micromilling being a constant preoccupation of the 20th century.

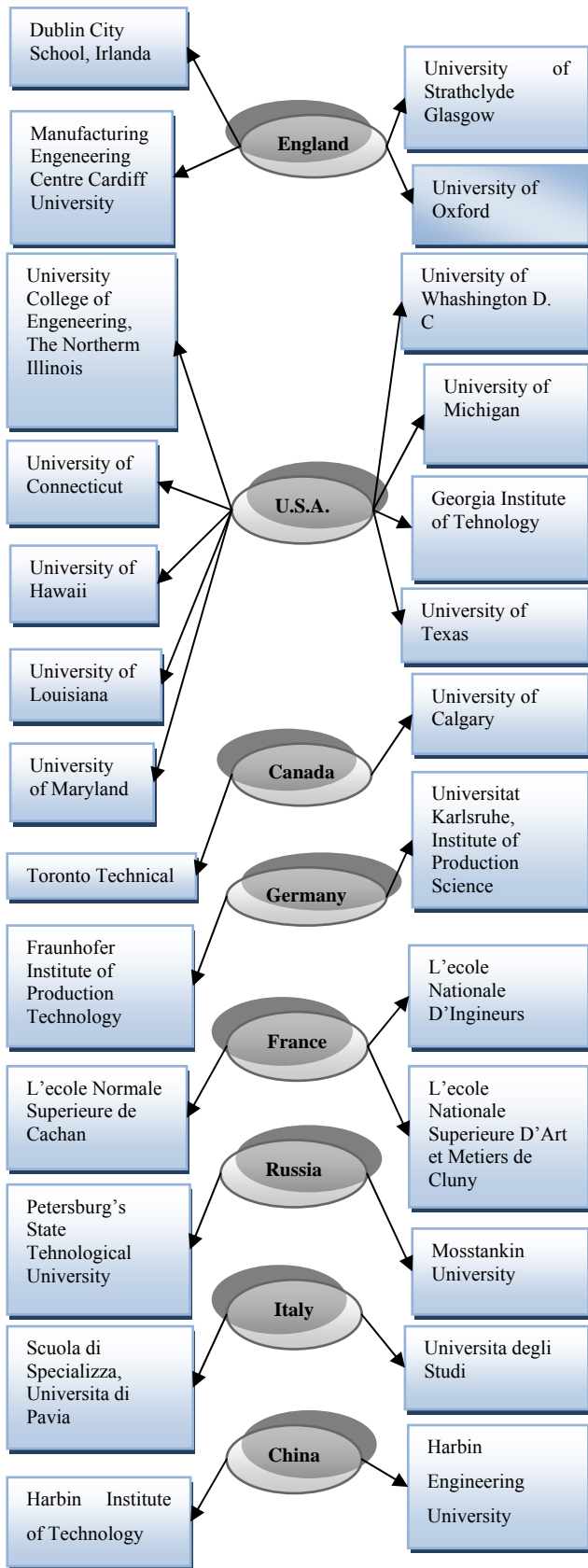


Fig. 2. Prestigious international schools in micromilling area

Some of the most famous schools with over 30 years micromilling tradition are represented in the previous diagram.

Among companies that have investigated or have spent time producing mills or microtools, it worth mentioning those from UK, China, USA, Japan, France, Germany, Canada, Switzerland, Australia and Russia.

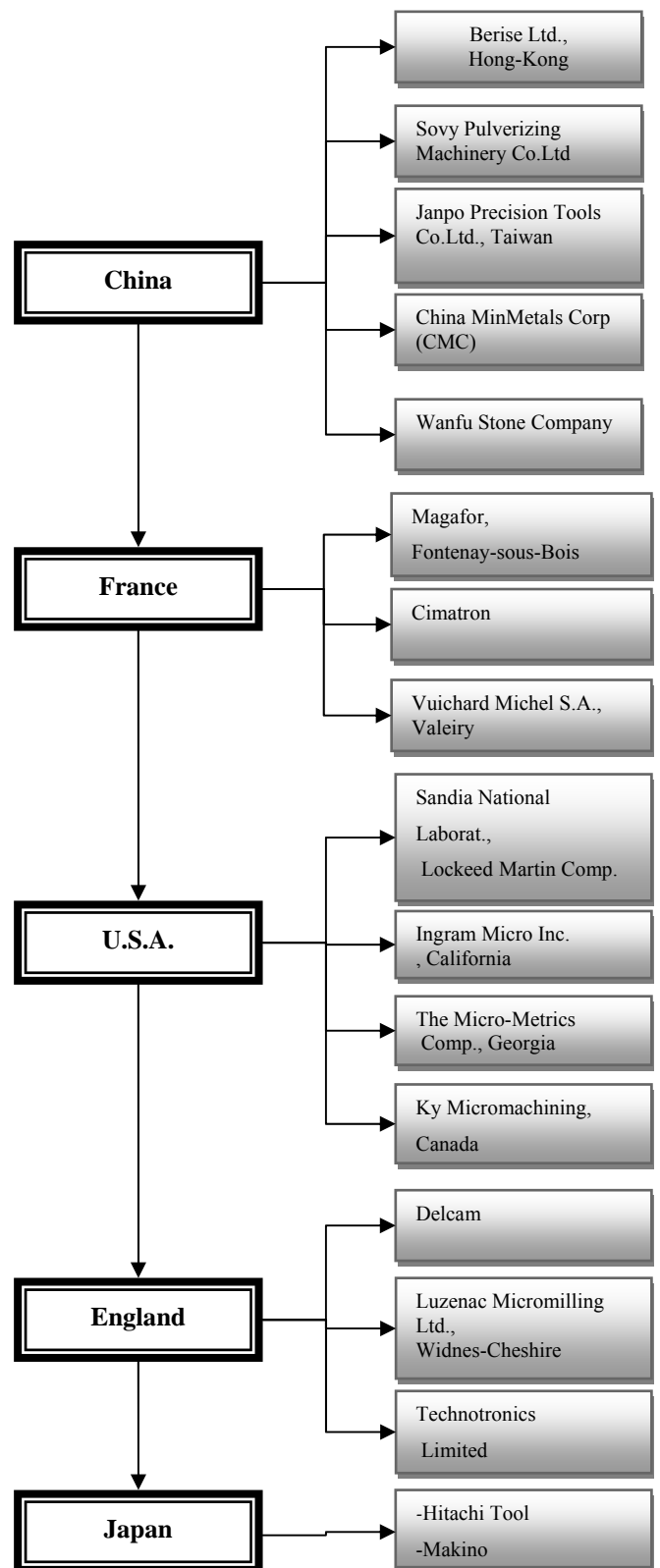


Fig. 3. Manufacturers of devices and tools for micromilling

The first researces in the micromilling area were by Piispanen, by developing the oldest model of the cutting process (1937, 1948), know as the model "playing cards". Merchant, in 1945, developed a modeling system of the forces, establishing equations for describing the process mechanics.

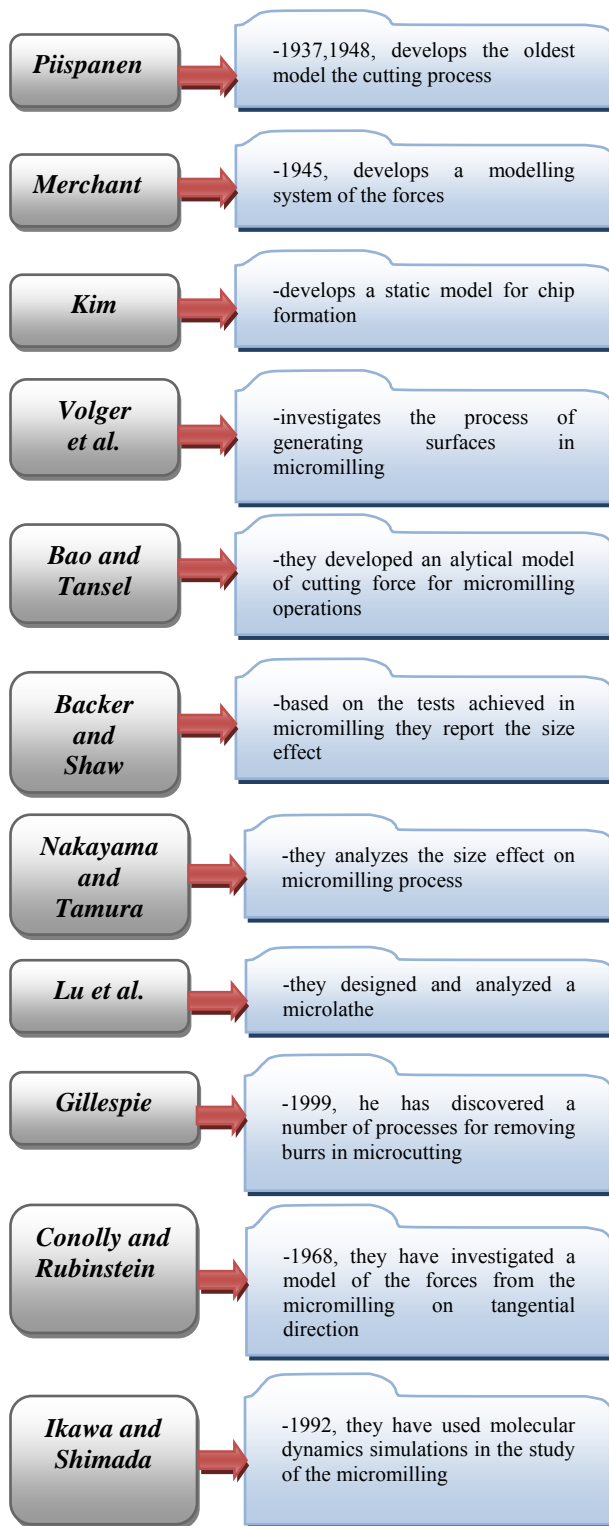


Fig. 4. Important researchers in the micromilling area

From the analyze of the researches achieved by the researchers from all over the world, we can remark those realized by: Kim, Merchant, Volger, Bao and Tansel, Backer and Shaw, Nakayama and Tamura , Lu, Gillespie, Chuzhoy, Connolly and Rubenstein, Fanga, Ikawa, Shimada, etc.

Investigations for the development of micromilling performances and widening the possibilities of industrial application have been developed and is ongoing in many other centers in the world (and by many other researchers) wich haven't been mentioned here.

4. Conclusion

Processing by micromilling is one of the most modern manufacturing methods because it fulfills all the claims of accuracy and ultraaccuracy, appearance, shape, etc.

The main purpose of processing by micromilling is improving the material's being cut surface , compared to the state obtained by other processing methods.

The development of miniaturized technologies has become a global phenomenon with applications in diverse fields.

Explored in the past 50 years and further, cutting at microscale is a relatively new area, using for miniaturization of engineering components.

For certain areas, it is the most economical method of fine mechanics, considering the extremely high quality claims imposed on them.

Due to the multitude of researches in micromilling area, it is very difficult to establish a current stage. We have realized it after bibliographic consultations we had access to, trying to highlight the outstanding interests in this area and their evolution over time.

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