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Recent Research Trend in Laser-Soldering Process

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The trend of the microjoining technology by the laser-soldering process has been reviewed. Among the production technologies, joining technology plays an important role in the fabrication of electronic components. This has led to an increasing attention towards the use of modern microjoining technology such as micro-resistance spot joining, micro-soldering, micro-friction stir joining and laser-soldering, etc. This review covers the recent technical trends of laser-soldering collected from the COMPENDEX DB analysis of published papers, research subject and research institutes.

Keywords *: high density energy beam, microjoining, laser-soldering technology*

1. Introduction

It is well known that microjoining is a critical technique for fabricating the electronics and electrical etc, and laser-soldering technology provides high level mechanical, chemical, and metallurgical properties.[1)-2)] The integration of the various joint properties into the investigation of laser-soldering technology will be a key component to the successful joint quality of the electronics, electrical, and bio/medical etc. The advanced microjoining technology offers controlled heating, low heat inputs, low distortion joints and the ability to operate at high production rates in a flexible manner.

The purpose of this review is to investigate the research trends of microjoining technology including the high quality advanced joining technology such as laser-soldering which is based on the published research works in the joining technology of electronics and bio/medical areas obtained from the KISTI's database, COMPENDEX DATA BASE SYSTEM, and also deals with the detailed background data of the laser-soldering technology.

2. Characteristics and Trend of the Laser-Soldering Technology

The microsoldering process combined with high density energy beam has a great efficiency in the fabrication of microjoined components compared to the ordinary microsoldering process. There are two types of high density energy beam, electron beam and laser beam, which are used in the joining process, and the comparison of the advantages of each process is shown in Table 1.

Compared to the electron beam, the laser beam has great potential flexibility for use in industry since the laser beam can be transmitted a substantial distance which provides the opportunity for multi-station working. Modern electronic component packaging technology is demanding new techniques for the interconnection of devices.[3)] The use of laser-soldering to join the microjoints make a major contribution of electronics manufacturing, and this applicability is a result of both improved laser beam technology and soldering technology in which laser energy interacts

Table 1. Comparison of the high density energy beam

Electro Beam	Laser Beam
• very good atmospheric protection • high energy density and low net energy input • beam control by magnetic beam focus	• being able to operate in any desired atmosphere • no special atmosphere or vacuum required • wide possibility for automation • absence of harmful ionizing radiation

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with materials used in soldering.[4)-5)] The laser-soldering is advantageous in the fields of microjoining due to its high reproducibility and the possibilities of local and temporal controlling the laser beam.[6)-7)] Fig. 1 shows the laser-micro-soldering system composed with Nd:YAG laser, 3-axis controller, working stage, beam scanner, cooler/bias supply, and personnel computer, etc.[8)]

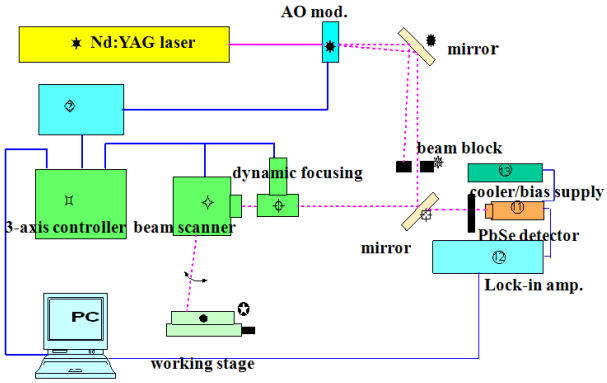

Fig. 1. Laser Micro-Soldering System

3. Technical Information Analysis

COMPENDEX** covers the trend of the volume of annually published papers concerning laser-soldering technology including the contents of those papers which were mainly experimental and theoretical. Search query and information analyzing process is shown in Fig. 2. The trends of the volume of annually published papers concerning laser-soldering technology are shown in Fig. 3, and it is observed that the number of papers has markedly increased

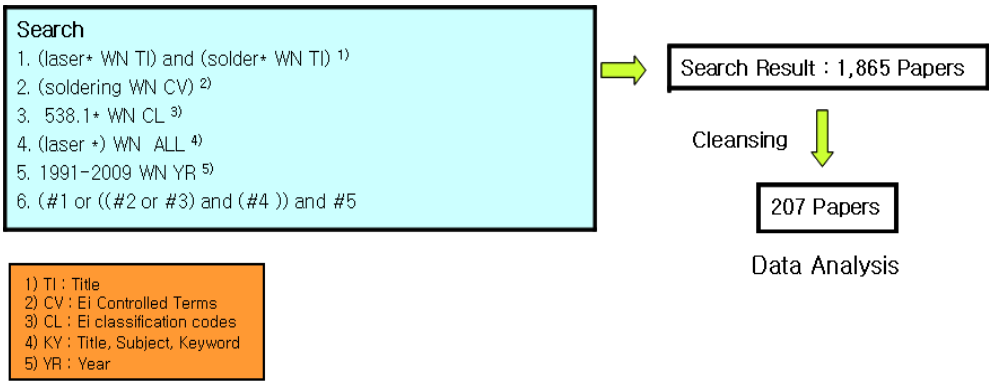

Fig. 2. Search query and information analyzing process

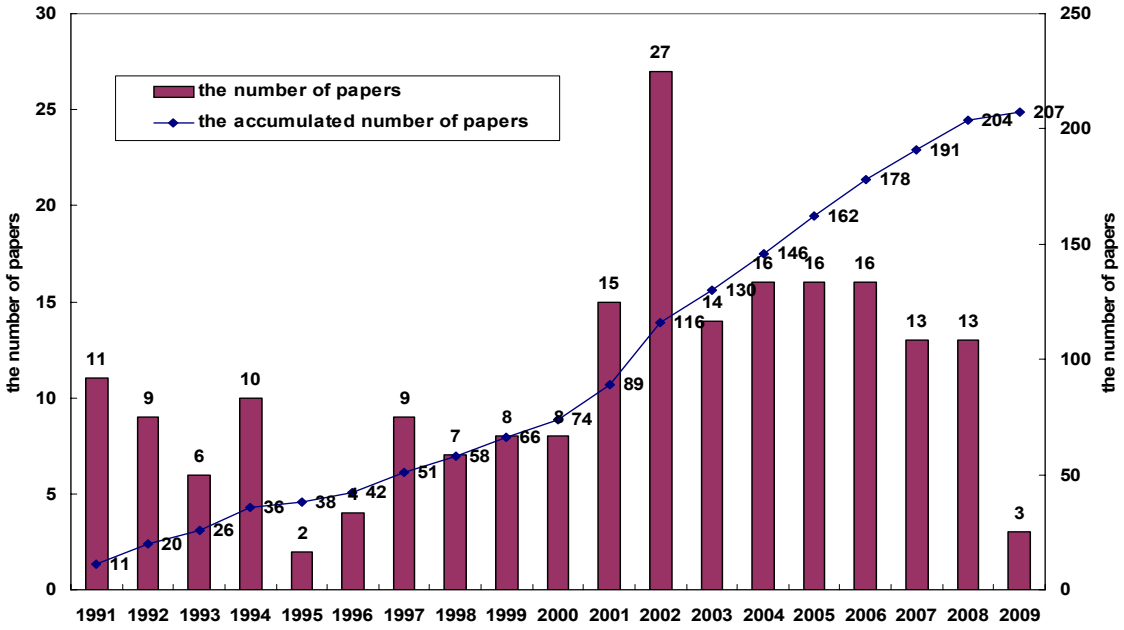

Fig. 3. Comparison of the Published Papers (Year)

in 2002.

The reason of this increase is due to the active paper publications on the Proceedings of SPIE-The International Society for Optical Engineering (International Society for Optical Engineering, Bellingham, WA 98227-0010, United States). They published 27 papers between 2001 and 2003, i.e. 6 papers in 2001, 13 papers in 2002, and 8 papers in 2003, respectively. The laser-soldering process is an important joining technology in the bio/medical science as well as in the electronic/electrical industry.

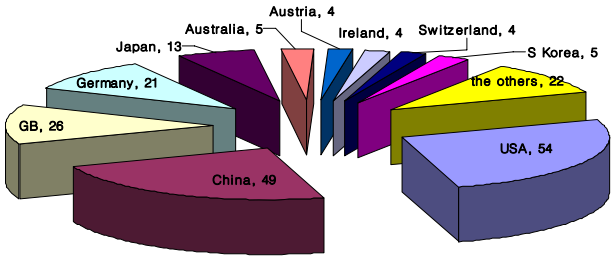

Fig. 4. Comparison of the Published Papers (Country)

Fig. 4 shows the country's research trends of laser-soldering technology, and shows that U.S.A. and China ranks top in publishing the papers.

Fig. 5 shows the research trends of laser-soldering technology in the electronic/electrical industry and bio/medical science in the 21st century. The detailed analysis reveals that 6 papers concerning the bio/medical science were pub-

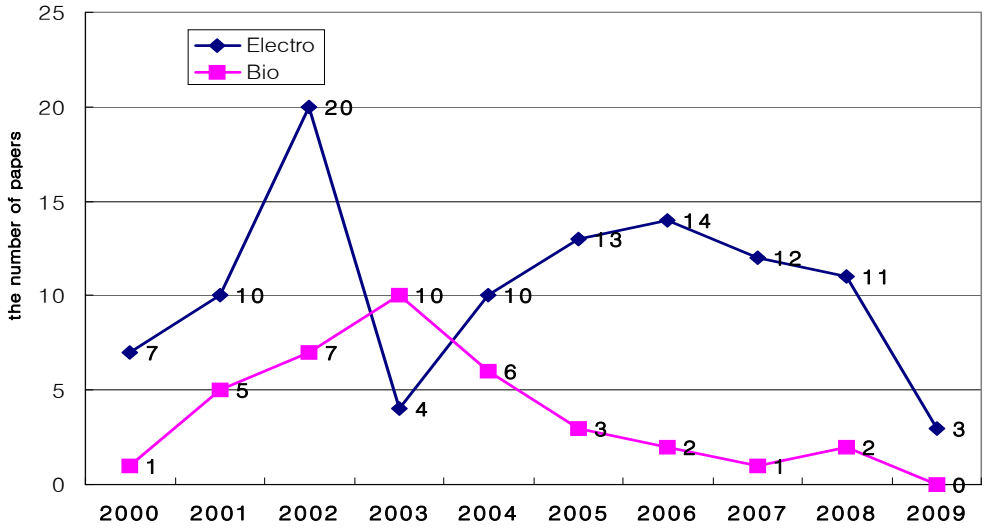

Fig. 5. Comparison of the Published Papers (Subject/Year)

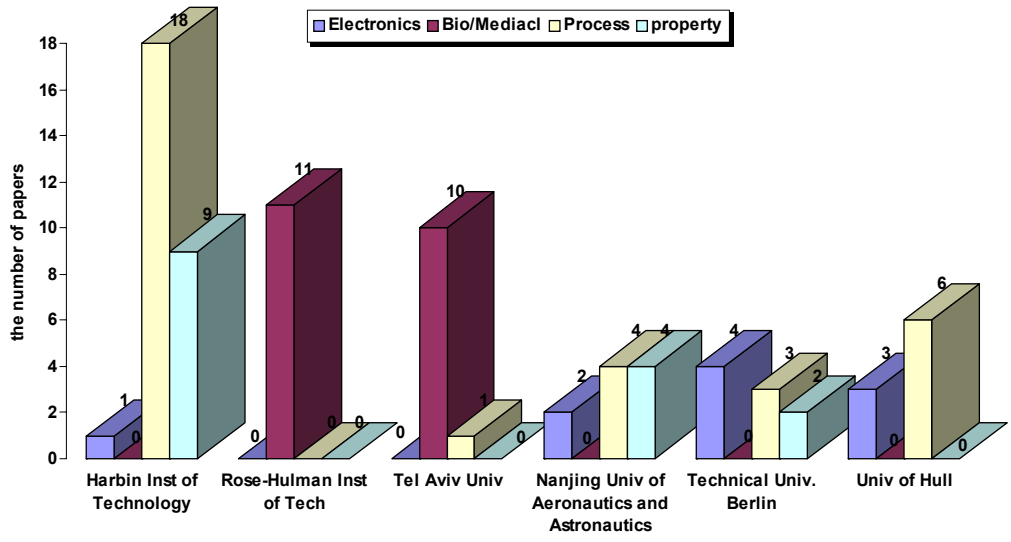

Fig. 6. Comparison of the Published Papers (Institute/Subject)

lished on the Proceedings of SPIE-The International Society for Optical Engineering in 2003.

According to the Ware,[9] the solder is activated by an 808 nm diode laser, which denatures the albumin, causing the albumin to bond with the collagen of the tissue. Fig. 6 shows the Research Institutes and research subjects. The laser-soldering technology developments in the bio/medical science are mainly conducted by the Rose-Hulman Institute of Technology (United States) and Tel Aviv University(Israel).[10)-12)]

4. Conclusions

In this review, the recent technical trends of laser-soldering technology for the electronic packaging, biological organs, etc. has been investigated. It was found that much effort are focused to the electronic/electric industry, bio/medical science, laser-soldering process, and property of the laser-soldering joints which have great potentials application and flexibility with the advantages of high efficiency for the achievements of reliable high quality laser-soldering joints. The wide application of these advanced microjoining processes will be expected in near future.

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