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AITC ASIAN INDUSTRIAL TECHNOLOGY CONGRESS '99

PROGRAMME

26 - 29 April 1999

Hong Kong Convention and Exhibition Centre

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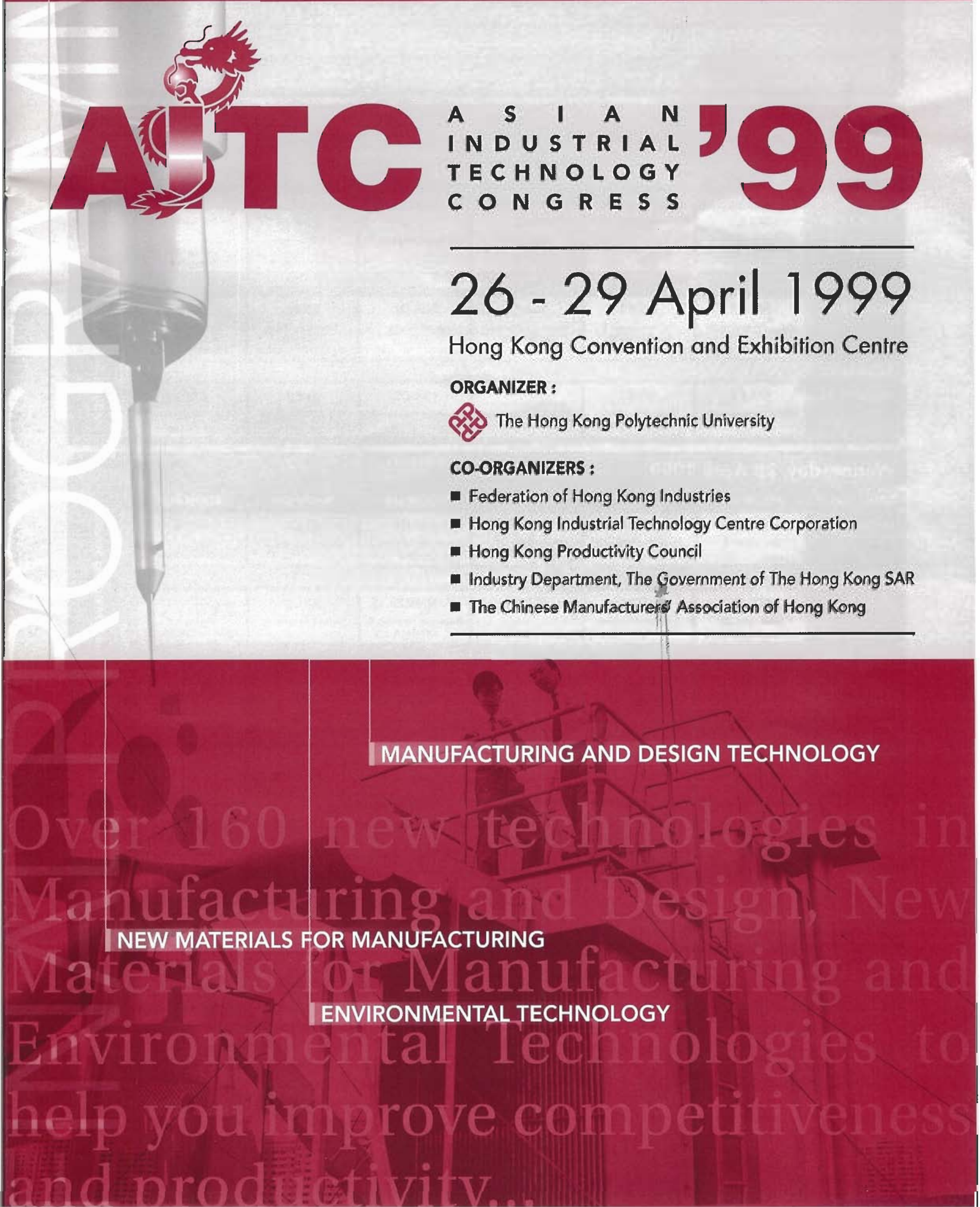
- Hong Kong Industrial Technology Centre Corporation
- Hong Kong Productivity Council
- Industry Department, The Government of The Hong Kong SAR
- The Chinese Manufacturers' Association of Hong Kong



MANUFACTURING AND DESIGN TECHNOLOGY

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Over 160 new technologies in Manufacturing and Design, New Materials for Manufacturing and Environmental Technologies to help you improve competitiveness and productivity.

11:00-12:30

Metal Processing (5) Rm 608

MT-A9-1

The Development of Intelligent Ejector-Pin for Injection Moulding

Hiroaki KAWASAKI, Futaba Corporation, Japan

An ejector-pin with pressure sensor was developed. Inside pressure of the mould cavity can now be effectively measured to improve the productivity of the plastic moulding.

MT-A9-2

Surface Property Enhancement by Plasma Treatment

Paul K. CHU, City University of Hong Kong, Hong Kong

Plasma immersion ion implantation (PIII) is a fledgling surface treatment and materials synthesis technique. The presentation will review the technology and applications in the materials, metallurgical, microelectronics, and biomedical industry.

MT-A9-3

High Precision Polishing - Comparison between Conventional Approach & Advanced Technology

Anthony Chi-Ying WONG, The University of Hong Kong, Hong Kong

This paper focuses on effects of polished metal surface of a mould/die on the quality of a plastic product. Emphasis will be placed on the value-added aspect by comparing various conventional and new polishing techniques.

Scanning & Rapid Prototyping (2) Rm 607

MT-B9-1

Recent Experiences with the SLS Rapid Tooling Process

Ian GIBSON, Centre for Advanced Product Development Technologies, The University of Hong Kong, Hong Kong

A report on the recent implementation at The University of Hong Kong of LR2 Rapidtools, a process for direct fabrication of injection mould tooling using the SLS RP process.

MT-B9-3

Study and Application of RP Tooling

Chen LU, Shanghai Jiao Tong University, China

A new RP tooling system has been developed. Its advantage and industrial applications are demonstrated through a real-life case example.

MT-B9-4

USC Technology Transfer Showcase - New Technologies on Manufacturing

Caroline MENDEZ, Engineering Technology Transfer Center, University of Southern California, U.S.A.

With 6 manufacturing and design technologies available for license, there is what a company needs to make itself more competitive in today's global marketplace. These technologies can be turned into revenue and increases profitability.

Resourcing & Scheduling Rm 604

MT-E9-1

Maintaining Competitiveness & Productivity with Intelligent Scheduling Technology

Hon-Wai CHUN, City University of Hong Kong, Hong Kong

The presentation describes how new software technologies can help Hong Kong companies to become more competitive and productive by planning, scheduling, deploying, and managing valuable corporate resources more efficiently. Typical resources of concern are machinery, personnel, equipment, and space.

MT-E9-2

Succeeding in the New Millennium with Customer-Centric ERP Solutions

Steve YEUNG, Platinum Software (North Asia) Ltd., Hong Kong

Platinum Software presents Platinum ERA, an integrated customer centric ERP solution specially designed for mid-sized companies. Platinum ERA Manufacturing suite is a comprehensive, client/server application designed to make manufacturing operations, including hybrid, repetitive, make-to-order, configure-to-order or job shop, more efficient.

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SURFACE PROPERTY ENHANCEMENT BY PLASMA TREATMENT

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Abstract

Plasma immersion ion implantation (PIII) is a novel and attractive technique to synthesize advanced materials and introduce value adding features to industrial products. A state-of-the-art plasma laboratory has been established in the City University of Hong Kong using funding from the Hong Kong Research Grants Council, City University of Hong Kong, Hong Kong University of Science & Technology, and Hong Kong University (Fig. 1). In addition to basic and applied research, the plasma laboratory is producing commercial equipment and designing processes for the microelectronics, metallurgical, aerospace, oil, and biomedical industry. For example, we are working with Komatsu Electronic Metals in Japan to produce the substrate materials for next generation microelectronic chips economically. With the sponsorship of the Hong Kong Industry Department, we are manufacturing commercial plasma implantation systems. Our latest order came from the Materials Engineering Department of Southwest Jiaotong University in China and the equipment will be employed to enhance the blood compatibility of artificial hearts.

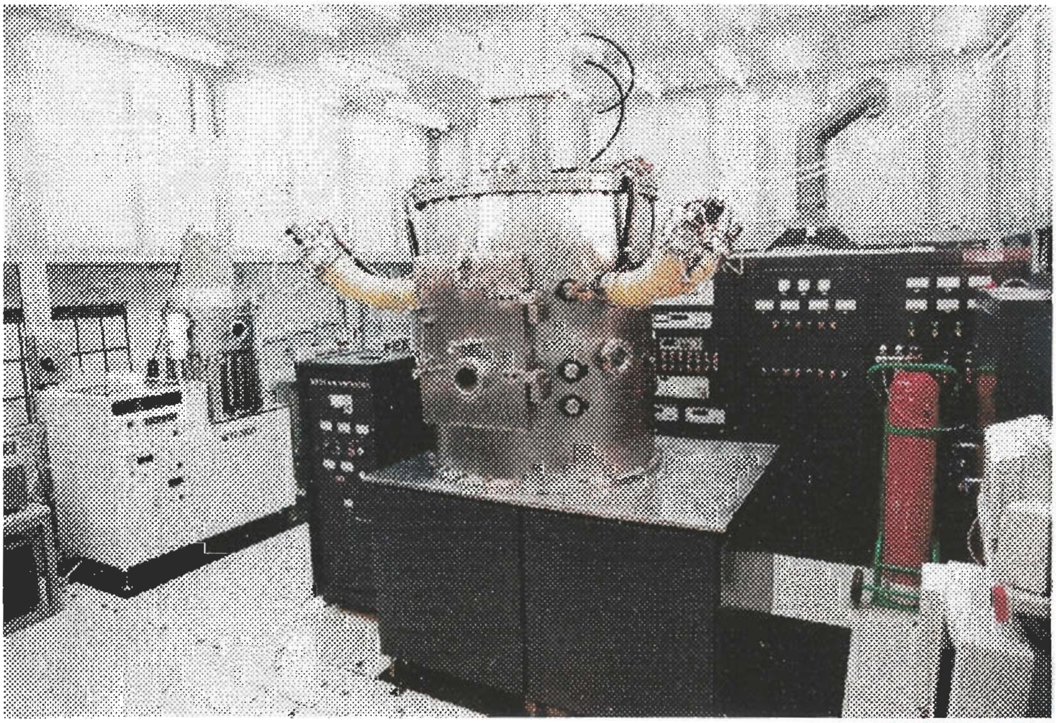
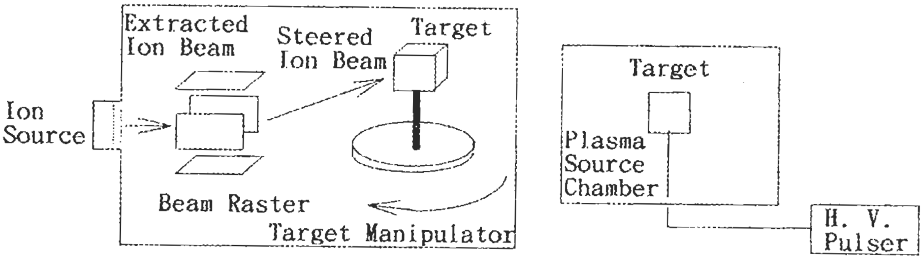


Fig. 1*: Plasma Laboratory in a Class-1000 Cleanroom*

I. Introduction

Plasma immersion ion implantation (PIII) is a burgeoning technology in materials synthesis and surface modification [1-3]. Unlike conventional beam-line ion implantation in which the ion beam is scanned to cover the entire sample, the sample is placed directly inside a plasma in PIII. Therefore, industrial samples that are large or have an irregular shape can be treated without sample manipulation or beam scanning as well as at a high throughput. The comparison is illustrated schematically in Fig. 2.



Beam-line Implantation

(Line of sight process)

PIII

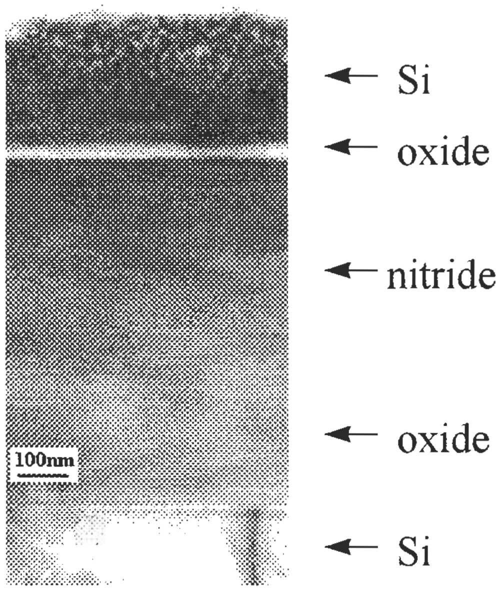
(Ions bombard all surfaces)

Fig. 2: The left figure depicts conventional beam-line ion implantation which is a line-of-sight process whereas in plasma immersion ion implantation (right figure), ions are implanted into all surfaces of the target simultaneously.

The technique has found many applications in the microelectronics, metallurgical, aerospace, oil, and biomedical industry. More than 100 scientific papers were published by the plasma group in the City University of Hong Kong from 1996 to 1998, and over ten US patents were filed in 1998.

II. Applications

The technology has been proven to be a viable process in semiconductor processing, the most notable being flat panel display [4], silicon-on-insulator (SOI) [5-8], plasma doping [9], and fast integrated circuits [10]. In the flat panel display industry, polycrystalline silicon has many advantages over the more common amorphous silicon in the manufacturing of active matrix liquid crystal displays. The lifetime and efficiency of the products can be enhanced by using PIII to introduce a high concentration of hydrogen into the FPD materials. IBM announced in 1998 that they would use SOI to manufacture their low-voltage, high-speed integrated circuits, and many other semiconductor producers are quickly following the industry leader. Staff members of the Plasma Laboratory in Hong Kong are currently collaborating with a company in the Silicon Valley in California and Komatsu Electronic Metals in Japan to develop an economical method to manufacture SOI substrates by PIII. Fig. 3 is a cross-section transmission electron microscopy (X-TEM) picture of the SOI materials produced by the PIII / ion-cut technique showing the excellent interfaces and quality of such materials.



- He implantation: 33 kV, 10^{17}cm^{-2}
- Wafer bonding: room temp.
- Wafer separation: ~ 500°C, 60 mins.
- Final annealing: 1100°C, 60 mins.

Fig. 3: XTEM picture of Silicon / SiO_2 / Si_3N_4 / SiO_2 / Silicon Substrate structure synthesized using helium PIII and Ion-Cut. The top silicon wafer was implanted using a helium plasma at 33 kV with a dose of 1×10^{17} atoms-cm^{-2}. The bonded interface is between the top oxide and nitride layers.

Plasma doping is envisioned to be the substitute for conventional ion implantation in deep sub-micrometer integrated circuits, and an international plasma doping users group (PDUG) has recently been established to commercialize the technology. Membership includes most of the big international semiconductor and equipment producers, including IBM, AMD, Applied Materials, Eaton, Varian, Panasonic, Canon, Nissin, and so on. The official PDUG home page is on the CityU network at *http://www.cityu.edu.hk/ap/plasmausers/home.htm*.

With regard to the more traditional metallurgical industry, we are working with the Chinese Ministry of Aerospace and Chinese Department of Nuclear Energy to prolong the lifetime of strategic and critical components [11]. On the commercial front, we are working with Daqing Oil Company in Heilongjiang to improve the performance of their underground oil pumps [12]. We have also established Plasma Technology Ltd. to produce commercial plasma treatment equipment. A plasma immersion ion implanter worth about HK$3 million was recently sold to Southwest Jiaotong University in Chengdu to enhance the bio-compatibility of artificial hearts. It is expected that the PIII market will expand rapidly when the industry becomes more aware of the added value provided by plasma treatment.

III. Conclusion

Plasma immersion ion implantation is moving out of the research laboratory and will undoubtedly find more applications in the microelectronics, aerospace, metal, and biomedical engineering industry as people learn more about this fledgling technology. Our mission is to develop relevant applications, provide industrial consultation and services, as well as to commercialize the technology via technology transfer and manufacturing of commercial equipment. Updated information on the activities of the plasma laboratory can be found on the Plasma Laboratory Homepage at: *http://www.cityu.edu.hk/ap/plasma/default.htm*.

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