'94 MATERIALS & TECHNOLOGY

北京化工大学与韩国忠南大学首届学术报告会论文集

沈曾民 主编

PROCEEDINGS OF THE FIRST INTERNATIONAL JOINT SYMPOSIUM BETWEEN BEIJING UNIVERSITY OF CHEMICAL TECHNOLOGY AND CHUNGNAM NATIONAL UNIVERSITY

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Message of Congratulation

by Chancellor of Beijing University of Chemical Technology

I warmly congratulate the successful opening of The First Bilateral Academic Symposium sponsored by Chungnam National University, Korea and Beijing University of Chemical Technology, China.

The symposium marks a new stage of friendly relations between our two universities. This is not only beneficial to both universities but also is of great significance in strengthening the traditional friendship and the cultural exchange between the two peoples.

BUCT, one of China's key institution of higher learning oriented toward chemical industry, has various disciplines in engineering, science, management and arts.

In order to meet the need of China's four modernization and development of the country's construction, to usher in the 21st century and foster high-level scientific and technical personnels, we actively carry out the high education reform, work out new development program, make great efforts to extend disciplines and widen specialities. We attach importance to high-technique to speed up the development of our university.

International exchange and cooperation is a major way to expidite high education development. This is conducive to broadening our outlook, into the recent development in science and technology, promoting mutual understanding internationally, learning from other's strong points to offset one's weaknesses, and use the advanced experience of other countries for reference. This First Bilateral Symposium held by our two universities is a significant practice. This academic exchange will undoubtedly promote the understanding between professors of our two universities.

I hope they will thereby establish research cooperation relationship. I am sure there will be some joint reports and thesis worked out by professors of the two universities at the next bilateral symposium.

I sincerely wish the symposium will be great success.

Thank you.

樊丽秋

Fan Liqiu, Chancellor of Beijing University of Chemical Technology

Congratulatory Address

July 21, 1994

It is my privilege to deliver this congratulatory address at the Joint Symposium between Beijing University of Chemical Technology and Chungnam National University which is entitled " '94 Materials and Technology ".

In retrospect, Korea has had very close relations with China from cultural and geographical viewpoint. I understand that we have been further cementing friendly ties between two countries by means of cultural and academic exchange since Korea have formal diplomatic agreement with China in 1992. At this juncture, academic cooperation with Beijing University of Chemical Technology is very meaningful for strengthening academic development of the two institutions and for the promotion of better understanding between the two nations.

It is my yiew that this symposium is significant in understanding of science and techonology in materials field. I am sure that this meeting will also greatly encourage the internationalization of our two institutions.

Finally, I sincerely hope that this sympsoium will provide a golden opportunity to exchange valuable knowledge and experience as will as deepen and strengthen our relationships and a collaborative spirit between two institutions. I would like to convey my appreciation to all the staff members, participants and attendance for their valuable effort to organize this symposium.

With best wishes for the success of the joint symposium organized by BUCT.

Duck Kee Jung

Duck-kee Jung
President
Chungnam Naitonal University
Taejon, Korea

CONTENTS

Development and Application of Carbon Fibers and Polymer Composites in China

Shen Zengmin(沈曾民) Wang Huiqiong(王惠琼) and Lu Yafei(吕亚非)

(Institute of Carbon Fiber Composites, Beijing University of Chemical Technology, Beijing 100029, China)

1. Introduction

High performence reinforcements are defined as specific strength$>6.5\times10^6$cm and specific modulus$>6.5\times10^8$cm and advanced composite materials (ACM) are defined as specific strength$>4.0\times10^6$cm and specific modulus$>4.0\times10^8$cm. Carbon fibers are one of the most important reinforcements and their composites are ACM. The market of ACM were transfered in recent years from aero-space industry to transportation, machinery, chemical and sports industry. In this paper, development and application of carbon fibers and polymer composites in China especially in Beijing University of Chemical Technology (BUCT) are introduced [1-3].

2. Carbon Fibers

2.1 PAN-based carbon fibers

2.1.1 Precursor

When carbon fibers were just studied in 1960's polyacrylonitrile fiber was used as precursor.In 1990's a few of factories have produced special acrylic precursor, as shown in Table 1.

Table 1. Specification and production capacity of the precursor

Manufacturer	Capacity (t / a)	Process	Tensile strength CN / dtex	Fineness dtex
Lanzhou Factory Chem. Fibers	60	NaSCN	5	1.11
Jilin Factory of Fiber Materials	90+200 *	HNO_3	5	1.21
Yuci Factory of Chem Fifers	380	DMSO	4-5	1.23
Shanghai Institute of Synthetic Fibers	5	DMSO	>4.5	1.10

* being built

2.1.2 Carbon fibers

In 1960's general purpose of carbon fibers were produced by batch process. In 1973 both air and catalytic methods of continuous carbonization process were developed by Shanxi Institute of Coal Chemistry and Beijing Institute of Chemistry respectively which built the basis of carbon fibers industry in China. A pilot line with capacity of 1 t / a based on air method was built in 1976 and carbon fibers were produced with tensile strength 2.6GPa,modulus 200 GPa and elongation 1.3%. In 1980's a 100t / a factory was built at Jilin Factory of Fiber Materials and carbon fibers were produced with tensile strength$>$3.0 GPa, modulus$>$ 220 GPa and elongation$>$ 1.4%. In BUCT a 6 t / a pilot line also built in 1980's. Now BUCT has a device for producing high modulus carbon fibers. The total production capacity in China is about 150 t / a. In 1990's carbon fibers with high tensile strength and intermediate modulus are developing at BUCT.

2.2 Pitch based carbon fibers

General purpose of pitch based carbon fibers with tensile strength$<$1.0 GPa, Modulus$<$40 GPa and elongation$>$2.0% were developed in 1978 and now a 10 t / a pilot line has built. Recently an isotropic pitch based carbon fibers factory with capacity of 200 t / a was built in Liaoning province which was imported from Ahland, USA. High performence mesophase pitch based carbon fibers were developed in BUCT with tensile strength 3.0–3.4 GPa, modulus 760–830 GPa and elongation 0.4% which is nearly the level of the advanced countries.

2.3 Rayon based carbon fibers

There are three factories producing rayon based carbon fibers, as listed in Table 2.

Table 2. A list of rayon based carbon fibers production factories

Manufacturer	Capacity (t / a)
Nantong Company of Activated Carbon Fibers	10
Liaoyuan Factory of Special Fibers	2
Liaoyuan Factory of Fiber Materials	3

3 Polymer Composites

3.1 Thermosets

Most thermosets are used as matrix in carbon fibers composites. The application of epoxy resin and polyimides have been notably successful becauce of their excellent adhesive characterization. Addition of thermoplastics such as TPI, PES, PEEK and PEK–C to epoxy resin the toughness of modified epoxy resin can be increased. Table 3 and 4 show the properties of modified epoxy resin which are the research results of BUCT.

Table 3 Properties of PEK–C and PES modified epoxy resin

Systems	Tensile strength,MPa	Modulus,GPa	Elongation,%	Tg, ℃
TGDDM / F–51 / DDS	86.1	3.9	2.5	238
TGDDM / F–51 / DDS / PEK–C	86.5	3.6	3.1	240
TGDDM / E–51 / DDS	83.4	3.9	2.8	235
TGDDM / E–51 / DDS / PEK–C	96.5	3.8	3.6	233
TGDDM / E–51 / DDS / PES	82.5	3.8	3.1	225

Table 4 Properties of PAI modified epoxy resin

Systems	Flexture strength, MPa	Modulus, GPa	Fracture energy, G_{IC}	Tg, ℃
TGDDM / DDS	385	58.6	812	–
TDE–85 / DDS	466	58.6	988	280
TDE–85 / DDS / PAI	531	49.0	1612	290

3.2 Thermoplastics composites

3.2.1 Properties

Thermoplastic composites have advantages of unlimited shelf life, low scrap or recyclability,rapid fabrication cycle and toughness or impact resistance. BUCT has developed chopped and continuous carbon fibers reinforced PEEK, nylon 6, 66, and 1010 composites. Table 5,6 and 7 show the properties of the composites.

Table 5 Properties of short carbon fibers / PEEK composites

Content,%	Tensile strength,MPa	Modulus,GPa	Elongation,%	Impact strength,KJ / m
0	98	4.3	11.0	8.5
10	171	10.9	3.7	9.7
20	181	13.1	2.0	10.4
30	231	24.5	1.7	11.2

Table 6 Properties of 30% short carbon fifers reinforced nylons composites

Samples	Tensile strength,MPa	Impact strength,KJ / m^2	Coefficient of friction
Nylon 6	117.6	8.1	0.182
Nylon 66	167.8	13.0	0.247
Nylon 1010	88.8	8.0	0.184

Table 7 Continuous carbon fibers / thermoplastics composites

Samples		Flexture strength,MPa	Impact Strength,KJ / m	ILSS,MPa
PEK–C,	30%	877	114	41
	38%	1048	98	46
	44%	1042	83	53
PES,	30%	950	70	66
	40%	971	55	51
	50%	980	56	50
PDC–2,	30%	493	108	59
	40%	699	109	66
	50%	1000	55	66

3.2.2 Products and applications

BUCT has developed and applicated many thermoplastics composites as follows: Carbon fibers reinforced PEEK are used for magnetic pulp. Carbon fibers / nylons are used for rapier head in textile machinery. Carbon fibers / PC are used for making gears of precise meter. Carbon fibers / PTFE / PPS are used for mechanical sealing parts and carbon fibers / POM are used for gears in textile machine.

4 Prospect

4.1 According to theoretic calculation at present real tensile strength of carbon fibers only reached to 4–8% of theoretic values. Hence the property of carbon fibers can be further increased. It should be noted that the key factors are to eliminate flaw and microcraze of precursor, to apply tension to spinning, preoxidation and carbonization process and to make enhanced structural ordering within carbon fibers.

4.2 To reduce the cost of carbon fibers through extending the application areas and developing low price carbon fibers and composites.

4.3 Many research projects of carbon fibers and composites is undertaking inChina. But development and application of carbon fibers and composites to industrial fields are relatively weak which limited their development. We hope that in order to promote the development of carbon fibers and composites collaboration research should be strengthen.

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A Study on Character Extraction from book covers for an OCR System

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(Dept. of Computer Engineering, ChungNam National University, Teajeon, Korea)

1. Introduction

We describe a new pre-processing algorithm for the recognition of titles in book covers. It has two distinctive characteristics compare to the document OCR system. The first is that the covers are generally color graphic images. The second is that the size and font of characters are irregular. Those make a difficulty in applying traditional pre-processing methods that were developed for the text region extraction on papers and documents[1,2,3]. To extract individual characters in cover, colors are clustered. After that, we select the character regions and apply the color band filtering on the regions. Finally, touched characters are separated by modified projection method. The proposed algorithm is implemented and tested more than 70 covers. Text regions are successfully extracted on about 85% of covers. The separation ratio of the touched characters in text regions is about 95%.

2. Color clustering

Colors coordinate of the image is changed from RGB to HSI. This transformation makes color components decoupled from intensity. For color clustering, 1D histogram of the image in Heu axis is smoothed by scale-space filtering[4]. From that, we select the peaks which are local maximums of the histogram, and those peaks are to be center of the clusters. Using the minimization of sum of squared distance, the rest colors are assigned to the color of the nearest cluster center. This processing also reduces noise generated by image input device such as scanner and video camera.

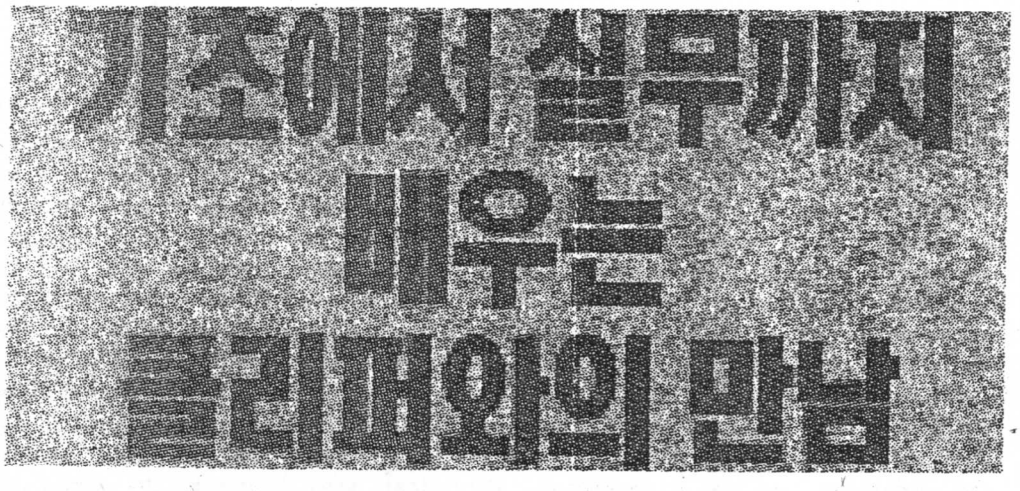

Figure 1. color input image

3. Character regions searching

We search for all the connected pixels using the 8-direction tracking method for the each clustered color except the most dominant color that represents the background. Then, we generate the minimum box that encompasses the connected pixels. Checking the ratio of width and height of the boxes and using statics of the box sizes, too small or too large boxes which should be considered as backgrounds are discarded. Also, by evaluating fill factors of the boxes and the relative position information of the boxes, graphic elements are discarded. Color band filtering is applied for the selected boxes to get the monochrome image of the boxes. If there are overlapped boxes, their position are temporally moved for the correct filtering. The filter cutoff value is selected as a mid-value of two peaks in bimodal histogram. There are some cases where histograms have more than two peak colors. In this multimodal case, we select multi-cutoff values which ensure that the color of the character will be in a pass band.

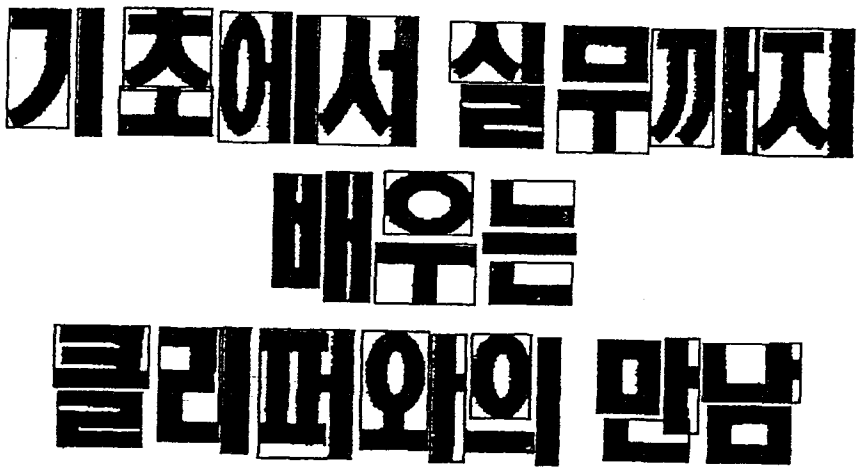

Figure 2. contour tracking image

4. Character Extraction and Segmentation of touching characters

From monochrome image of the cover, we extract lines by projecting from left to right. Then we sort the boxes to align the lines. The boxes are mostly parts of a character, or include more than one character. In case, the boxes are parts of a character, we merge the boxes to a character based on statistical and structural methods. Then there is no overlapped boxes. Just we need only to separate the characters on the wide boxes. In Korean and Chinese characters the width and height of characters in the same line are almost same. We search the most frequent width of boxes, and consider it as a normal width of a character. The box whose width is larger than the normal width is inferred as touching characters, and separate the box based on the normal width and pre-located and post-located boxes information. We repeat the merging process again to include the separated box to a character. This last step improves the ratio of separation[5].

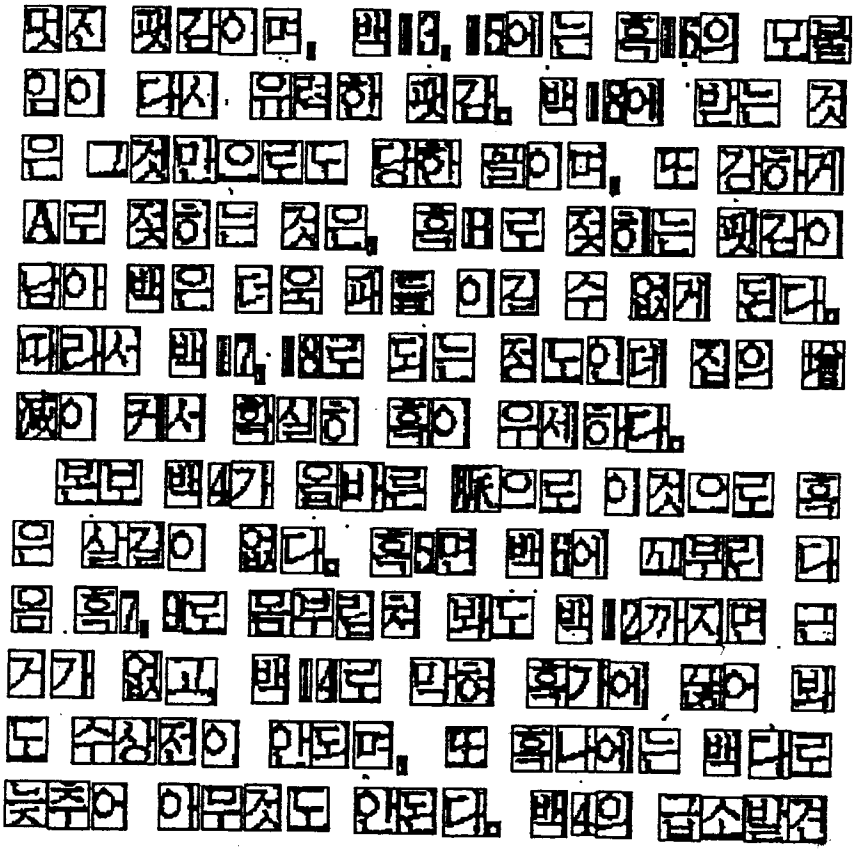

Figure 3. proposed method image

5. Experiment and Conclusion

The algorithm has implemented on PC486 in C language. Handy scanner and flat-bed type scanner are used to input cover images with 200 and 300 DPI resolutions and 256 colors. We tested this algorithm on more than 70 covers. The result shows that we have accurately extract the character regions on about 85% of covers and separate with 95% case of touched characters. So, it shows about 81% success ratio. Figure 1.a shows a sample color image; figure 1.b, its' monochrome image and figure 1.c segmented image. Figure 2 is another sample monochrome document image to show a capability of the character segmentation method. For future study, the proposed algorithm should be improved to handle the true color images. Also it needs some reference images to compare the efficiency of the algorithms in this area and to provide objective experimental results.