Paolo F. Calvini, Chiara Fornaciari da Passano and Nella Poggi on behalf of Group 130°

Use of the Korean mulberry paper *hanji* in book and paper conservation: When a traditional material meets new techniques

The *Jikji* and Group 130°

The *Jikji* is one of the most important texts of Korean Buddhism, and was printed and published in the same year as the coronation of Richard II. The edition of *Buljo Jikji Shimche* was printed with Goryeo movable metal type on *hanji* paper; it arrived in Europe as part of Victor Émile Marie Joseph Collin de Plancy's private collection and then was transferred to the Bibliothèque National de France in Paris, where was rediscovered in 1970 by Park Peyong-Seon. From its rediscovery, a further 31 years passed before the history of *Jikji* become known all over the world: in 2001 it was added to the UNESCO Memory of the World Register, as the earliest printed book in existence.

In 2007, Nella Poggi Parigi visited Korea, and specifically the Cheongju Early Printing Museum and the National Korean Living Treasure of movable metal type; furthermore, she had the opportunity to visit some Korean paper conservators and papermaking studios. This trip was an original and unique way to learn about the *Jikji*'s history, as well as a way to experience traditional Korean craftsmanship, as enshrined in the *Jikji* itself. [1]

Following this trip, Nella Poggi wished to share this wonderful experience with Italian and European colleagues and to make widely known the existence of a very high quality paper that can be used for conservation purposes; but how could this best be achieved?

The first step was, in cooperation with the Cheongju Early Printing Museum, the donation of *Jikji*'s anastatic reprint to several Italian libraries, starting with the library of Santa Scolastica in Subiaco, cradle of the Italian printing tradition. Following this, the General Consulate of the Republic of Korea, in cooperation with the Biblioteca Trivulziana at Sforza Castle and paper conservator Minah Song (as external facilitator), organized a workshop on *hanji* paper in Milan, offering 10 scholarships. Last but not least, a cooperation with Walt Disney Company, Italy, gave birth to the publication of a comic story about *Jikji*, with Mickey Mouse as special guest.

Following the workshop on *hanji* paper in Milan, some of the participants decided to keep the professional links alive and so established *il Gruppo 130°* (Group 130°).

Analysis of *hanji* paper

One of the first activities of the Group was to test the use of *hanji* in comparison with *washi* paper, both on original artefacts and mock-ups. All conservators were aware of the fact that the noun *hanji*, along with the so-called *washi* (Japanese) paper, are not trademarks, but an endoethnonym (*hanji*, Han = Korea, Ji = Paper) and an exoethnonym (Korean paper).

For this reason, in order to further study the production, supply and industry chain, papers for testing were selected from the CTS catalogue.[2] The 10 conservators involved chose to perform treatments on books, Western, Indian and Arab paper, leather and parchment, three-dimensional objects

1 For further reading please see: Park Byeng-Sen, *Minje. Korean Printing, from its origins to 1910*, Korean Studies Series (Seoul: Jimoondang, 2003), Appendix, 180–207; Aimee Lee, *Hanji Unfurled: One journey into Korean papermaking* (Ann Arbor: Legacy Press, 2012); Cheongju Early Printing Museum, *Traces of Jikji and Korean moveable metal types: in commemoration of the 10th anniversary* (Cheongju City: Cheongju Early Printing Museum, 2004).

2 CTS is a leading Italian company, which has been operating at a national and international level for over 20 years. It is a supplier of a wide range of products and equipment for cleaning, consolidation, protection and conservation of works of art of artistic, historical and monumental interest. Customers include the most important restoration and conservation institutions, organizations and museums, as well as most private operators in the Italian peninsula and abroad. CTS is the primary Italian supplier for the conservation field, sponsor of the CPD *hanji* course held in June 2014 in Milan, and is now selling *hanji* paper in Italy, France, Spain, Romania, Switzerland, Turkey and India. For more information see: http://www.ctseurope.com/en/index.php.

and photographs. Toning, lining, inpainting and loss compensation tests were also carried out on mock-ups. Between December 2014 and February 2015, 25 original artworks were treated, with some still works in progress.

Google Forms (which is an online survey tool provided by Google) was used to collect data in order to monitor these activities. This idea, suggested by Barbara Cattaneo and Alessandro Sidoti from the National Library of Florence, helped ensure uniformity in treatment description and individual responses. First of all, a collective practice syllabus was compiled by the partners, and then, having carried out all the tests, the partners individually completed surveys on the following subjects: the temporary and permanent uses of *hanji* papers selected from the CTS catalogue, the response to adhesives, the response to toning and inpainting and, at the end, overall impressions.

The tests confirm that *hanji*, especially *hanji* roll (80% mulberry fibre, 20% mix fibre, CTS), can be used for temporary applications including as an alternative to Gore-Tex®, TNT or polyester web during wetting, drying, flattening and lining, and can be reused several times before fibres get damaged. Wet strength, flexibility, good surface texture, lack of strong grain direction and pliability were appreciated. *Webal* paper, *hanji* 1303 (19 g/m² wood drying, *webal* formation) gave the best result, along with *hanji* roll, which is particularly useful for oversize formats.

In order to select and use papers for permanent applications, conservators need to take into account many aspects: grams per square metre, chromaticity, laid or wove, thickness, surface texture, but also transparency and opacity, the pH (which may influence the hue in case of toning), a lack of strong grain direction, freedom from impurities and long fibres. *Hanji* meets these qualities.

All the partner conservators agreed that the *hanji* papers selected from the CTS catalogue tended to be transparent if applied to certain Western artefacts. However, it provided good results on tracing paper infillings and light, transparent paper. As with Western handmade papers, we noticed that *hanji* surface texture tends to vary depending on the type, quality, date of fibre extraction and place of manufacture. We found that a rough surface finish can be a problem when toning, but on the other hand it can be easily shaped through pressing, burnishing and glazing.

With regard to uniformity, as with Japanese, and handmade papers in general, we noticed that sometimes the handmade *hanji* papers are not consistent in grams per square metre. Their thickness and weight does not exactly match the retailer's claims. *Hanji webal* paper[3] appears to be very stable and resistant. The pH of mulberry paper tends to be slightly alkaline, and this can affect toning, especially with pH-sensitive dyes. Coating with gelatine or klucel-G can minimize the risk of colour shift.

If we were asked to describe the possible uses for these papers, we could say that *hanji* 1101 is good for toning, mending tears and backing; that *hanji* 1201 is good for toning, mending and lining; that *hanji* 1303 is good for humidification and flattening, toning, for consolidation and to reinforce the spine of bindings; that *hanji* 1308 is good for toning and mending, especially parchment, as well as to reinforce the spine, corners, and so on; that *hanji* 1401 is good for flattening, mending parchment and leather, while *hanji* roll is good for humidification, washing, flattening and lining oversize formats. To conclude, *hanji* has many positive characteristics, proving to be stable, strong and resistant with its long fibres.

Group 130° tested the fibre type, colour, weight, thickness, strength, absorbency, dimensional stability, pliability, surface texture, transparency and translucency, and opacity of these papers. The decision will depend on whether the application is temporary or permanent, and the preference of the paper conservator.

3 *Hanji webal* papers are made using an indigenous Korean mould, have no strong grain direction and are formed of two layers (called *yumyangji* or 'Yin and Yang'). For more information on manufacture and special features see: http://www.ifides.com/products01.1.html.

Only the paper conservator's practical experience can be a guide as to the choice of mulberry paper for conservation purposes, but, to date, *hanji* has proved to be a valuable alternative to other papers, being competitive from an economical point of view, stable and, most important, widely available.

We hope that a certification quality network around *hanji* papers in the future will maintain the highest standards, and that distributors selling mulberry papers will provide all relevant technical information. As paper conservators, we must certify almost every product we use in our job, and we also need to know which kind of paper we are using on behalf of our business, and on behalf of the entire chain related to the production of mulberry paper for paper conservation applications. This aspect is very important because it will protect the original producers, who are qualified artisans, and the culture and traditions of the origin countries.

Analysis and comparison of Korean and Japanese papers available in the Italian market: physical, mechanical and chemical characteristics

Several technical analyses have been performed on six out of eight specimens used in this project (Table 1), four *hanji* papers and two Japanese *kōzo* papers, which were included for comparison.

Handmade *hanji* 1303 and 1308 differ in their formation techniques, that is, *webal* and *ssangbal* respectively. The former technique assures a more isotropic distribution of the fibres, while the latter yields a paper sheet with fibres more oriented in one direction, similar to the machine direction in modern papermaking. *Hanji* 1401 is about the same thickness as the other sheets, and has a slightly higher grammage.

Table 1 Physical, mechanical and chemical evaluations of six different *hanji* and *kōzo* papers available on the Italian market.

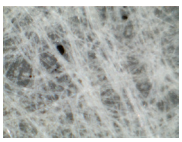
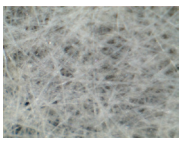
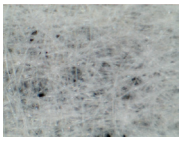
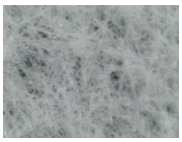
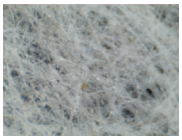
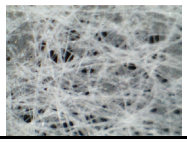
Sample	Photo (800x)	Dimensions	Declared grammage g/m2	Measured grammage g/m2	Measured thickness (μ)	Fabrication	Composition	Measured pH
Hanji 1303		660 x 930mm	19	22.2	70.9	Handmade, laid, *webal*, wood dried	100% *chamdak*	7.6
Hanji 1308		660 x 930mm	19	17.9	66.9	Handmade, *ssangbal*, wood dried	100% *chamdak*	8.6
Hanji 1401		660 x 930mm	25	27.2	70.9	Handmade, laid, *webal*, wood dried	100% *chamdak*	7.3
Hanji roll		910mm x 30m	30	29.4	85.3	Machine-made	80% mulberry, 20% pulp	8.6
K43		560 x 930mm	29	25.9	85.3	Handmade, laid, steel dried	100% *kōzo*	8.4
K35		620 x 980mm	18	15.4	57.5	Handmade, laid, steel dried	100% *kōzo*	8.4

Table 2 Index of technical analyses.

Technical data
Determination of grammage and thickness
Determination of pH of aqueous extracts
Determination of wettability (contact angle)
Determination of capillary rise—Klemm method
Determination of tensile strength before and after immersion in water
Determination of CIE whiteness, d65/10 degree
Determination of air permeability and roughness—Bendtsen method

It must be highlighted that the *hanji* roll sample has been included in this research project because of its lower cost and higher versatility. However, the roll was not produced for specific use in paper restoration; it contains 20% bleached wood-pulp and perhaps some optical brighteners that might compromise its permanence and durability. The list of technical analyses is gathered in Table 2.

It is well known that mechanical properties depend upon the grammage and thickness of the samples. These properties vary in *hanji* and Japanese papers made for different purposes, and were therefore checked, with satisfactory results of homogeneity.

As many conservation treatments are aqueous, the wettability and the capillarity of the paper sheets were analysed. The wettability can be evaluated from the contact angle between the paper and a drop of water poured onto its surface, while the capillary rise is the height reached by the waterfront in a vertical strip of paper kept partly immersed in water (Fig. 1). The results, shown in the Tables below, indicate that all the samples but K 35 are easily wettable, as the angle of contact is 0° after 20 seconds (Tables 3 and 4).

The higher contact angle and the lower value of capillary rise of K 35 suggest that this sample has been treated to decrease its interactions with water, and should be more thoroughly analysed.

Another important property of paper used for conservation purposes is the tensile strength, either in dry or wet conditions. Table 5 shows the ultimate mechanical properties of the analysed paper sheets at the point

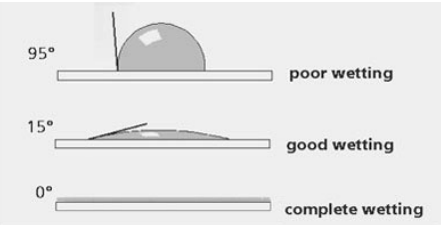


Fig. 1 Contact angle and wettability.

Table 3 Results of wettability and contact angle tests on *hanji* and *kōzo* sheets.

Contact angle												
Time of contact	*Hanji* 1303		*Hanji* 1308		*Hanji* 1401		*Hanji* roll		K 43		K 35	
	recto	verso	recto	verso	recto	verso	recto	verso	recto	verso	recto	verso
5 s	16.4	18.1	0	10.4	22.7	16.1	0	7.8	15.5	26.3	82.0	88.6
20 s	0	0	0	0	0	0	0	0	0	0	55.1	12.9

Table 4 Results of capillarity rise test on *hanji* and *kōzo* sheets.

Capillary rise						
	Hanji 1303	*Hanji* 1308	*Hanji* 1401	*Hanji* roll	K 43	K 35
mm	39.5	39.5	62.5	55.5	63.5	19.8

Table 5 Ultimate mechanical properties at failure of the analysed paper sheets.

Mechanical properties		**dry**		**wet**	
		x direction	y direction	x direction	y direction
Hanji 1303	Tensile strength (N)	26.2	26.8	1.8	1.4
	Elongation %	2.7	2.6	1.7	1.8
Hanji 1308	Tensile strength (N)	14.2	28.3	0.8	1.5
	Elongation %	2.8	2.8	2.1	2.1
Hanji 1401	Tensile strength (N)	36.2	26.5	2.5	1.9
	Elongation %	2.7	2.5	1.9	2.0
Hanji roll	Tensile strength (N)	17.3	18.4	1.9	3.5
	Elongation %	2.4	2.7	1.6	1.8
K43	Tensile strength (N)	18.6	42.7	0.8	1.4
	Elongation %	3.1	3.6	2.6	2.7
K35	Tensile strength (N)	9.4	19.7	0.4	0.7
	Elongation %	2.2	2.5	2.4	2.2

of failure. With regard to dry tests, the *hanji* 1303 sample, handmade with *webal* technique, appears isotropic in x- and y-directions, with about the same tensile strength, while the *ssangbal* technique yields some anisotropy in the *hanji* 1308 paper. However, these data should be taken with caution, as some values are controversial. The *hanji* 1401 sheet, for instance, made with *webal* technique, shows some anisotropy, while the *hanji* roll, which should have a stronger machine direction, appears isotropic. It is worth noting that the isotropy of fibre direction in paper sheets is an important property which minimizes the deformation of sheets in wet restoration techniques followed by drying. As expected, the wet tests yield much lower mechanical resistances, and the *hanji* roll appears to be the most resistant.

The surface roughness has been evaluated through the Bendtsen test, achieved by clamping the paper between a flat glass plate and a circular metal head, and measuring the rate of airflow in ml/minute between paper and head. As expected, all the samples are quite rough (about 1100 ml/minute) both on the recto and the verso. However, the *hanji* roll showed a significant difference on its felt and wire surfaces (900 and 1435 ml/minute respectively).

The same Bendsten test can be utilized to evaluate the air permeability, and all the samples were found to be completely permeable to air. This feature is particularly appreciable in the *hanji* roll, for its use on suction tables.

Referring to the whiteness of paper, two tests have been performed: the measurement of diffuse blue reflectance factor (brightness) and evaluation of colour in the CIE L*a*b* colour space, as shown in Table 6 (average of recto and verso sides). The *hanji* roll shows the highest brightness as well as the highest value of luminosity (L*). However, its blue component (b*) is very low and the red component (a*) shows a negative value. It is likely that these anomalous values arise from the bleaching of wood pulp and perhaps from the presence of optical brighteners.

Another problem typical of paper preservation science is the evaluation of paper permanence, and Table 7 outlines the analyses in this project. It is well known that fibres in paper are made mainly of cellulose, a polymer composed of glucose units linearly bound together. On average, cellulose chains contain about 1000 units, and it is said that cellulose has an average degree of polymerization (DP) of about 1000. Most of the inter-glucose

Table 6 Results of measurement of diffuse blue reflectance factor (brightness) and evaluation of colour in the CIE L*a*b* colour space on paper sheets.

	Brightness %	**L***	**a***	**b***
Hanji 1303	58.3	87.2	1.8	12.0
Hanji 1308	60.4	88.0	1.6	11.4
Hanji 1401	57.4	86.7	1.7	11.5
Hanji roll	84.1	94.4	-0.3	3.3
K43	48.2	82.8	2.0	15.7
K35	48.6	83.0	1.5	15.5

Table 7 Evaluation of paper permanence and analyses performed.

Evaluation of permanence—before and after accelerated ageing
Determination of the degree of polymerisation (DP)
Determination of tensile properties
Measurement of brightness and colour (L*a*b*)

bonds belong to crystalline fractions of cellulose and are very resistant to hydrolysis, while a few belong to the amorphous fraction and can be hydrolysed. During the degradation, the DP decreases to a value of about 150 (levelling off degree of polymerization or LODP), where nothing but crystalline regions remain and all tensile strength is lost.

In order to predict the paper permanence, at least three parameters are necessary: the initial DP (DP°), the final DP (LODP) and the rate of degradation reaction, characterized by a rate constant k. High values of k imply a fast degradation. The reaction can be accelerated by increasing the temperature (usually up to 80–110° C). Without entering in deeper scientific arguments, it can be said that the value of k can be evaluated from viscometric analyses (being the viscosity of a polymer solution proportional to DP) performed at increasing time intervals. When k at high temperature is known, its value at room temperature can be roughly deduced from the so-called Arrhenius Equation. The meaning of k can be better visualized by elaborating it in terms of degradation half-time ($t^{0.5}$, corresponding to the time to reach 50% degradation) and life expectancy ($t^{0.9}$ corresponding to the time to reach 90% degradation). Both degradation half-time and life expectancy of the analysed samples are shown in Table 8, together with other data, after Stephens and Whitmore, and Jeong et al.[4] The table shows the importance of initial alkaline pH: our samples (pH 7.3–8.6) will last 6000–13,000 years, while the life expectancy of *kōzo* paper (pH 6.0) is about 1750 years.

The detection of pH values in paper sheets declared neutral is of primary importance, as some alkalinity increases the life expectancy of paper, while it could influence the toning or restrict its use in other instances, for example, in the restoration of some photographic techniques particularly sensitive to the alkalinity.

Despite its lower DP°, the *hanji* roll shows a time stability similar to that of other *hanji* handmade papers. However, these data refer to hydrolytic degradation alone and should be confirmed by the evaluation of discoloration. To this end, the CIE L*a*b* analyses have been repeated after accelerated ageing (90° C and 50% RH). The results are expressed in terms of colour variation. Table 8 shows that accelerated ageing brings about low values of DE, barely appreciable with naked eyes. The *hanji* 1303 and 1308 as well as Japanese K 43 and K 35 samples appear less sensitive to accelerated ageing (compare the values of DE). *Hanji* 1401 and the *hanji* roll show

4 Catherine H. Stephens and Paul M. Whitmore, 'Comparison of the degradation behavior of cotton, linen, and kozo papers', *Cellulose* 20 (2013): 1099–1108; Myung-Joon Jeong, Kyu-Young Kang, Markus Bacher, Hyoung-Jin Kim, Byoung-Muk Jo and Antje Potthast, 'Deterioration of ancient cellulose paper, Hanji: evaluation of paper permanence', *Cellulose* 21 (2014): 4621–4632.

Table 8 Degradation half-time and life expectancy of the analysed samples in comparison with other data.[4]

	DP°	DP (20 days at 90°C 50% RH)	LODP	t0.5 (years at room temperature)	t0.9 (years at room temperature)	pH
Hanji 1303	2982	1660	157	2605	8653	7.6
Hanji 1308	3146	2003	152	3979	13217	8.6
Hanji 1401	2884	1416	153	1984	6591	7.3
Hanji roll	861	633	133	1751	5816	8.6
K43	3205	1678	150	2579	8566	8.4
K35	3350	1832	150	2966	9853	8.4
Kōzo paper	3440	1320	350	525	1750	6.0
Naturally aged *Hanji* paper	9000		1000	1415	4700	?

relatively high values of DE, due to different causes: a drop of luminosity L* for *hanji* 1401 and a yellow-red shift for the *hanji* roll, possibly due to the degradation of wood pulp.

Finally, the evaluation of tensile properties before and after accelerated ageing does not show a clear decrease, indicating that only a few hydrolytic scissions per chain occurred and that accelerated ageing should be tested, for a longer time period.

Conclusions

The exploratory technical analyses performed on these *hanji* and Japanese papers suggest that Korean and Japanese papers are comparable for use in restoration processes.

Both Japanese and Korean handmade paper sheets appear poorly homogeneous, but it is likely that the same lack of homogeneity occurs in ancient book leaves, allowing the use of *hanji* for restoration processes.

The *hanji* roll may become brown-yellowish with natural ageing, and its recto and verso sides are very different. While these properties may raise doubts about its suitability for permanent conservation treatments, its air permeability, wetting/capillarity properties and mechanical resistance in wet conditions do make it suitable for temporary treatments, such as humidification/flattening and washing by capillarity/suction table.

In any event, the *hanji* or Japanese papers include a variety of different commercially available paper items with different composition, methods of fabrication and grammage, which require deeper analyses to ensure they fit the requirements of conservators for specific uses.

Further technical analysis carried out as part of a broader project with leading Italian research institutes will, in the near future, determine the assessment of *hanji*'s paper quality grade; the results of this ongoing project will be communicated by ICRCPAL on their website.[5]

5 Istituto Centrale per il Restauro e la Conservazione del Patrimonio Archivistico e Librario (ICRCPAL): http://www.icpal.beniculturali.it/primo_piano.html?resourceType=/xml-content/archivio_primo_piano/0-2016/0-13-12-2016-LocandinaCorea.

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Abstract
Hanji mulberry paper is a traditional material in the history of Korean papermaking and has been of extraordinary importance in the transmission of Korean culture; the *Jikji*, the first known book printed with movable type, was printed on *hanji* paper in the year AD 1377. In Asia, *hanji* has been used in book and paper conservation ever since, but its use amongst European conservators is scarcely documented. The present work will contribute toward a better comprehension of this material, of its mechanical features, its durability and possible applications in the conservation of paper-based items. In this work, the authors will investigate the particular aspects of *hanji* paper and will evaluate its applicability in the conservation of a range of historical and artistic items in the form of book, graphic art and photograph. Mechanical reactions of *hanji* paper to stress, and its resistance to wear and tear will be evaluated through its use in conjunction with different materials, for example, baritate photographic supports, vellum and tanned leather book structures. The present work is also part of a broad project which includes collaboration with leading Italian research institutes. The authors have different professional backgrounds and specializations: they are all conservators in different fields, such as Western books, Asian, Arabic and Eastern books, artworks on paper and photographic materials. Research Group 130° was born after the authors took part in a Continuing Professional Development (CPD) course on the use of *hanji* paper in conservation which took place in Milan in June 2014.

Biographies
Paolo F. Calvini graduated as a chemist from the University of Rome in 1971. He was Paper Preservation Scientist at the Istituto Centrale per la Conservazione e il Restauro del Patrimonio Archivistico e Librario (ICRCPAL) in Rome from 1974 to 1999 and then head of the Laboratory of Diagnostics and Conservation of Cultural Heritage at the Soprintendenza ai Beni Architettonici, in Genoa from 1999 to 2009. Now retired, he has been a visiting Professor of Chemistry of Paper Materials at the University Ca' Foscari of Venice since 2007. His scientific interests are the simulation of natural ageing and the kinetics of degradation of paper materials, together with their FTIR analysis. Paolo F. Calvini is also author of several articles on these issues in leading scientific journals.
Chiara Fornaciari da Passano is a paper conservator. In 1980 she specialized in the restoration of drawings and engravings at the National Institute of Graphics in Rome; in 1983 she attended the course 'Conservation and restoration of books and archival materials' at the ICRCPAL in Rome; and in 1987 she completed her degree in History of Art at Rome's Sapienza University. In 1992 she specialized in restoration of tracing paper, attending the laboratory of restoration of works on paper at the Carnavalet Museum in Paris. From 1984 to 1994 she worked at the Vatican Museums as a freelance conservator and in 1995 became a permanent member of the team. In 2008 she became director of the Vatican Museum's laboratory for the restoration of works on paper. Since 2011 she has also been teaching restoration of art works on paper at Rome's Tor Vergata University.
Nella Poggi is a paper conservator in private practice. She established her studio in Milan, Italy in 2007. Since then she has been cooperating with several museums and public institutions in South Korea and Italy, with the intent to promote cultural exchange between Korean paper craftsmanship tradition and paper conservators. She holds a BA in Conservation and Certification of Advanced Studies from the post-secondary program in Art Conservation at the ENAIP Lombardia Foundation, Italy. Prior roles include: associate conservator of paper in the private practice of Lisa Forman at the Hudson Conservation Studio, Los Angeles; Mellon Fellow in paper conservation and, later, assistant conservator of paper at the Balboa Art Conservation Center, San Diego; summer intern in paper conservation at the Getty Research Institute, Los Angeles; and spring intern in paper conservation at the Museum of Modern Art, New York.
Group 130° is an independent group composed of paper, book and photograph conservators and scientists employed as permanent and temporary staff at the following institutions: University of Venice; Vatican Museums; Brera Fine Arts Academy; National Library of Florence; Barcelona Fine Arts University; Associazione Bastioni; Brescia Fine Arts Academy; National Archives of France; Department of Manuscripts, Ministery of Culture, Muscat, Oman; and other paper conservators in private practice in Italy, in cooperation with the General Consulate of the Republic of Korea, (MOFA) Milan.

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https://icon.org.uk/node/4998

Use of the Korean mulberry paper *hanji* in book and paper conservation: When a traditional material meets new techniques

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