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D E C I S I O N
of 3 June 1997

Case Number: T 0848/94 - 3.3.3

Application Number: 87100826.4

Publication Number: 0230984

IPC: C08L 79/08

Language of the proceedings: EN

Title of invention:

Polyimide film having improved adhesive properties

Patentee:

Kanegafuchi Kagaku Kogyo Kabushiki Kaisha

Opponent:

E.I. Du Pont de Nemours and Company

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56

Keyword:

"Novelty (yes) - prior public use not sufficiently substantiated"

"Inventive step (yes) - unexpected synergistic effect"

Decisions cited:

T 0192/82, T 0069/83, T 0472/92

Catchword:

-



Case Number: T 0848/94 - 3.3.3

D E C I S I O N
of the Technical Board of Appeal 3.3.3
of 3 June 1997

Appellant:
(Proprietor of the patent) E.I. Du Pont de Nemours and Company
1007 Market Street
Wilmington, Del. 19898 (US)

Representative:
Werner, Hans-Karsten, Dr.
Patentanwälte
von Kreisler-Selting-Werner
Postfach 10 22 41
D-50462 Köln (DE)

Respondent:
(Opponent) Kanegafuchi Kagaku Kogyo Kabushiki Kaisha
2-4 Nakanoshima 3-chome
Kita-ku
Osaka-shi
Osaka-fu 530 (JP)

Representative:
Vossius & Partner
Postfach 86 07 67
81634 München (DE)

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 1 September 1994
revoking European patent No. 0 230 984 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: C. Gérardin
Members: P. Kitzmantel
W. Moser

Summary of Facts and Submissions

- I. European patent application No. 87 100 826.4 in the name of KANEGAFUCHI KAGAKU KOGYO KABUSHIKI KAISHA which had been filed on 22 January 1987, claiming priority from a JP application filed on 23 January 1986, resulted in the grant of European patent No. 230 984 on 15 April 1992, on the basis of the following sole claim:

"A polyimide film produced by forming a film from a raw material composed solely or mainly of aromatic tetracarboxylic acid dianhydrides and aromatic diamines containing at least one finely divided inorganic powder selected from SiO_2 , TiO_2 , CaHPO_4 and $\text{Ca}_2\text{P}_2\text{O}_7$, having a particle diameter of not larger than $100\mu\text{m}$ that forms minute projections on the film surface and subsequently subjecting the film to corona discharge treatment at 20 to $500 \text{ W}\cdot\text{min}/\text{m}^2$."

- II. Notice of Opposition requesting revocation of the patent in its entirety on the grounds of Article 100(a) EPC was filed by E.I. DU PONT DE NEMOURS AND COMPANY on 24 December 1992.

In the course of the first instance opposition proceedings the Opponent contended in particular that the subject-matter of the patent in suit was not novel because polyimide films conforming with all requirements of the claimed subject-matter had been the subject of prior public use. Alternatively, the subject-matter of the patent in suit was also not novel over the disclosure in document

D7: JP-A-85 127 523 (considered in the form of an English translation), only filed in the middle of the oral proceedings.

Moreover, in the opinion of the Opponent the claimed subject-matter was also not based on an inventive step over a number of citations, including

D4: US-A-4 297 187, and

D8: "Kapton HN Investigations" by M.K. Williams et al. for Mound (operated by EG&G Mounds Applied Technologies for the U.S. Department of Energy) issued 28 September 1990.

III. By its decision of 14 July 1994, issued in writing on 1 September 1994, the Opposition Division rejected the opposition.

It was held in that decision that the evidence brought forward by the Opponent in support of an alleged prior public use of the polyimide films claimed by the patent in suit was insufficient. In consequence, and since furthermore none of the documents cited in the written opposition proceedings disclosed all features of the claimed films, the novelty of the claimed subject-matter was recognized. Document D7 was not admitted into the proceedings and dismissed as irrelevant.

It was also acknowledged in the appealed decision that the subject-matter of the patent in suit involved an inventive step, because it provided a non-obvious solution to the existing problem of producing polyimide films which did not block and exhibited an improved bond strength. In particular, the prior art did not suggest that by the incorporation of calcium diphosphate particles in combination with a corona discharge treatment of the films a synergistic improvement of the adhesion would be achieved.

IV. On 25 October 1994 the Opponent (Appellant) lodged an appeal against the decision of the Opposition Division and paid the appeal fee on the same day. The Statement of Grounds of Appeal submitted on 5 January 1995 made again reference to D7 and relied on three additional documents D9 to D11:

D9: Encyclopedia of Polymer Science and Technology, Vol. 11 (1969), pages 247 and 267,

D10: Supplemental Declaration of Mr Morton Katz, dated 13 June 1994, and

D11: Declaration of Mr Steve Wilkinson, dated 30 December 1994.

V. With letter dated 24 July 1995 the Respondent (Proprietor of the patent) submitted counter-arguments, also in connection with D7, against the contentions made in the Statement of Grounds of Appeal.

VI. In a communication sent in preparation of oral proceedings which had been scheduled for 3 June 1997 the Rapporteur specified (i) that the objection of prior public use would have to be proved up to the hilt as set out in T 472/92 and (ii) that D7 was to be regarded as sufficiently relevant to be admitted into the proceedings.

VII. In his written and oral submissions the Appellant essentially argued as follows:

(i) He maintained his original allegation of prior public use and contended that the evidence (Evidences I, II, III and IV) submitted with his letter dated 10 June 1994 demonstrated that aromatic polyimide films having all

characteristics as required in the patent in suit had been delivered, without any obligation of confidentiality, to Rexham UK before the priority date of the opposed patent.

The Appellant stressed in particular that Evidences II, III and IV proved the delivery in March 1985 of at least two rolls of a Kapton 100HAN film to Rexham UK, and that Evidence I demonstrated that Kapton 100HAN and 200HAN films had been produced by ED treatment (ED = electrical discharge) of corresponding **HN** films. While the power of the ED treatment was not indicated in Evidence I, the Appellant stated during the oral proceedings that this power had been estimated to be $480 \text{ W}\cdot\text{min}/\text{m}^2$. The Appellant admitted that the Kapton HAN films referred to in Evidence I were not those designated in Evidences II, III and IV, but contended that all Kapton HAN films, including those delivered to Rexham UK, had been produced by Du Pont to the same specifications.

Since according to document D9 Kapton polyimide film, Type H, consisted of poly(N,N'-(p,p'-oxydiphenylene)pyromellitimide), and since according to document D8 Kapton **HN** films commercialized by Du Pont early in the 1980s were Kapton H films including as slip additive CaHPO_4 particles in a size range of below $100 \mu\text{m}$, the Appellant concluded that the Kapton HAN films delivered to Rexham met all requirements of the single claim of the patent in suit.

(ii) With respect to the issue of inventive step, the Appellant mainly relied on a combination of documents D7 and D4. Document D7, he argued, disclosed aromatic polyimide films, whose runnability characteristics had been improved by the incorporation of small particles of a filler material, including SiO₂ and TiO₂. These films were furthermore subjected to a corona discharge treatment in order to enhance their adhesive properties. The Appellant contended that to one skilled in the art and confronted with the object to optimize the runnability and adhesive properties of such polyimide films, it would have been obvious to carry out the corona discharge treatment at a power of 500 to 3000 Joule/m² as disclosed in D4. By doing so one would arrive at polyimide films meeting all requirements of the sole claim of the patent in suit.

Alternatively, the Appellant argued, there was even no need to resort to the disclosure of D4 for construing an obviousness objection against the subject-matter of the patent in suit on the basis of D7; for the person skilled in the art it would even not involve an inventive effort to find out by routine experimentation the range of electrical power of the corona discharge treatment by which the desired improvement of the adhesive properties of the polyimide film surface could be achieved.

Furthermore, the Appellant stated that from the results in Table 1 of the patent in suit a synergistic effect, with respect to the achieved adhesive properties, allegedly caused by the presence of filler particles in the film and by the subsequent corona discharge treatment, could

not be inferred; the presence of a deposit of organic decomposition product on the film tested according to Comparative Example 3 rendered its comparison with "inventive" Example 3 meaningless. Furthermore, the Appellant's own experiments, summarized in Tables 1, 2 and 3 of his letter dated 30 April 1997, did not show any such synergism. This alleged "synergistic" effect could not, therefore, be used to support an inventive step.

Moreover, even if a synergistic effect existed, this was a mere "bonus" effect inevitably resulting from the obvious combination of documents D7 and D4.

- (iii) As an alternative starting point for the assessment of inventive step, the Appellant pointed to the Kapton HN films, whose commercial public availability before the priority date of the patent in suit was disclosed in D8. In the Appellant's view, it was obvious to improve the adhesiveness of these films by corona discharge treatment, a treatment known to the expert for the purpose of adhesion improvement from D7, D4 and even from the discussion of the state of the art in the patent in suit itself.

VIII. The arguments of the Respondent may be summarized as follows:

- (i) With respect to the issue of prior public use he stated **inter alia**
 - (ia) that the characteristics of the Kapton HAN films delivered to Rexham had not reliably been established by the Appellant's evidence, and

- (ib) that in all likelihood the deliveries from Du Pont to Rexham UK had been made under the aegis of an obligation of confidentiality.

Concerning issue (ia) he stressed in particular that Evidence I did not disclose the power of the electrical discharge treatment and was, moreover, unrelated to either one of Evidences II, III and IV. The statement by the Appellant during the oral proceedings that the power of the electrical discharge treatment as carried out according to Evidence I was $480 \text{ W}\cdot\text{min}/\text{m}^2$ was in contradiction to the Appellant's earlier statement (submission of 1 July 1994) that it was $550 \text{ W}\cdot\text{min}/\text{m}^2$.

With respect to issue (ib) the Respondent argued that one must conclude

- (A) from the character of the documents submitted as Evidences I to IV (Evidences I and II are internal Du Pont papers; with respect to the deliveries referred to in Evidences III and IV no order from and no invoice to Rexham UK have been produced by the Appellant), as well as
- (B) from the lack of any publications concerning Kapton HAN films,

that the deliveries identified in Evidences III and IV related to the early life of the development of these films during which the customer (Rexham UK), according to normal live experience, was bound by an at least conclusive obligation of confidentiality.

Therefore, the alleged prior public use had not been sufficiently substantiated.

- (ii) In his response to the Statement of Grounds of Appeal the Respondent asked that document D7, because of its filing at a very late stage of the first instance opposition proceedings, should not be admitted into the proceedings. After having been informed by the Rapporteur's communication that in the latter's preliminary opinion D7 was very relevant to the issue of inventive step, the Respondent did not during the oral proceedings mention this request any more.

With respect to the relevance of D7, the Respondent argued that the improved durability of the metal coated polyimide films disclosed therein was unrelated to the bond strength between the metal coating and the film. This document was therefore not an appropriate starting point for one skilled in the art seeking to provide films having improved adhesive properties.

Moreover, the materials attached to the polyimide films in D7 and according to the patent in suit would be different: on the one hand a metal coating **directly** applied to the surface of the polyimide film by vapor deposition, on the other hand a metal foil adhered to the film by action of an **intermediate** adhesive layer.

Furthermore, the Respondent stressed that document D7 offered a choice between two surface treatments - glow discharge and corona discharge - and was completely silent on the conditions under which these, particularly the corona discharge treatment, were to be carried out.

A further important distinction between the subject-matter of the patent in suit and the disclosure of D7 lay in the size of the filler particles. In the latter case this was in the range of 5 to 500 m μ (= 0,005 to 0,5 μ m), whereas according to the former the particles size should not be smaller than 1 μ m.

With a view to making this distinction more conspicuous, the Respondent during the oral proceedings submitted as an **auxiliary request** an amended claim which differed from the claim as granted only by the feature: "... having a particle diameter of not smaller than 1 μ m and ..."

In the Respondent's opinion document D4 was inappropriate for combination with D7, because the problem to be solved according to D4, namely the improvement of the adhesiveness of the surface of a plastic film for printing inks, was not referred to in D7. Furthermore, since the films disclosed in D4 did not comprise an inorganic powder, the corona discharge treatment would lead to film blocking which, according to the patent in suit, was to be prevented. Moreover, D4 mentioned polyimides only as members of a substantial list of plastic materials, and there was no example in D4 exemplifying its use.

Accordingly, even if, for the sake of argument, the disclosures of documents D7 and D4 were to be combined, the subject-matter of the application in suit would still be unobvious over such a combination.

IX. The Appellant requested that the decision under appeal be set aside and that the European patent No. 230 984 be revoked in its entirety.

The Respondent requested that the appeal be dismissed (main request) or that the patent be maintained on the basis of the sole claim submitted during oral proceedings as auxiliary request.

Furthermore, the Respondent requested that, in the event that the Board decided to introduce D7 into the proceedings, the case be remitted to the first instance and that the Appellant be ordered to bear the costs for a resumption of the first instance proceedings.

Reasons for the Decision

1. The appeal is admissible.
2. *Procedural matter (late filed documents)*

As it appears from the Statement of Facts and Submissions (point IV) the Appellant, to support his various objections, relied on document D7 which had been disregarded by the Opposition Division as having been filed late and being irrelevant, as well as on three new documents D9 to D11. All these citations have been duly examined by the Board.

This examination has brought to light that D7 was sufficiently relevant to be admitted into the proceedings (cf. intermediate communication of

12 March 1997). As to D9 to D11, without having been formally disregarded by the Board, they played no role at all during oral proceedings and will not be considered hereinafter.

Main request

3. *Novelty*

3.1 Prior public use

3.1.1 For the Appellant to prove that the subject-matter of the patent in suit has been made available to the public within the meaning of Articles 54(1)(2) EPC, he needs to establish:

- (a) the date on which the prior use occurred ("when" issue),
- (b) exactly what was in prior use ("what" issue), and
- (c) the circumstances surrounding the prior use (issue of confidentiality).

If one of these issues is not "sufficiently" proved, the Appellant's prior public use case must fail. As has been set out in Section 3.1 of T 472/92 (to be published) "sufficiently", in the case of prior public use, normally means "up to the hilt".

3.1.2 "What" issue

- (i) According to Evidence IV, comprising (1) a manuscript note from Rexham to DuPont, signed by "Steve", dated 18 March 1994, and (2) copies of two labels of the delivered materials, two rolls

of Kapton HAN film having the Mill Roll numbers 3622324 and 3622256 had been delivered to Rexham in March 1985.

- (ii) According to Evidence III, comprising (1) a "Straight Bill of Lading" from Du Pont de Nemours & Co. (Inc), Polymer Products Department carrying the date "03/11/85" and the "Shipment Identification Number 005W 38946" and (2) a "Manifest", comprising i.a. the information "SID No: 005W38946" (thus establishing that this "Manifest" belongs to the afore-mentioned "Straight Bill of Lading") materials were shipped from Du Pont to Rexham, which are identified in Evidence III by a "Plant Order - Account No. FHNP04503", which is identical to the "DuPont Order No." on the labels of Evidence IV, but for the last three characters "A00" which are missing), and by the information "Export Marks Rexham No 20102 Wrexham UK R87K3060", which latter number appears also on the labels of Evidence IV.

It can thus be concluded that the Kapton rolls identified in Evidence IV were part of the consignment which was delivered to Rexham according to Evidence III.

- (iii) According to Evidence II, comprising a test report entitled "KAPTON^(R) LAMINATER AND COATED FILM QUALITY RECORD" a sample of a Kapton 100HAN film, Mill Roll Number 3622324, was tested on 1 March 1985 and exhibited Pyralux Adhesion values of 8.7 and 11.9.

This evidence, thus, fits in with the facts concerning the delivery to Rexham of Kapton 100HAN film, Mill Roll Number 3622324, according to Evidences III and IV.

- (iv) As admitted by the Appellant, there is no specific evidence on file, concerning the nature and the characteristics of the Kapton HAN films delivered to Rexham according to Evidences III and IV.

It may, however, be concluded from documents D8 and D9 that Kapton HN is a polyimide film composed solely or mainly of aromatic tetracarboxylic acid dianhydrides and aromatic diamines (cf. D9) and containing a finely divided CaHPO_4 powder having a particle diameter of not larger than 100 μm , which powder forms minute protrusions on the film surface (cf. D8: page 3, last paragraph; page 7, Figure 2). The information contained in D8 relates to Kapton HN materials commercialized by Du Pont "early in the 1980s" (penultimate paragraph of page 3 of D8). It appears likely to a high extent that the Kapton materials delivered to Rexham in March 1985, i.e. before the priority date of the patent in suit of 23 January 1986, essentially conformed to the specifications set out in D8. It is not detrimental to the probative weight of the relevant information in D8 that this document was published in September 1990 only. The term "early in the 1980s" relates clearly to a period of time within the first half of this decennium, i.e. before the priority date of the patent in suit and this period of time also coincides with the time of production of the Kapton materials delivered to Rexham according to Evidences III and IV.

Evidence I, three pages of an internal Du Pont report, entitled "TA-4 (Rev. 8/13/84) KAPTON^(R) CIRCLEVILLE PLANT TEST APPROVAL", was adduced by the Appellant in order to demonstrate that the Kapton HAN films delivered to Rexham had been corona discharge treated in accordance with the requirements claimed in the patent in suit. However, this evidence does not relate to the materials delivered to Rexham; by contrast on page 3 of Evidence I a "Mill roll # 8111804 (100HN)" is identified, which is different from the mill roll numbers 3622324 and 3622256 indicated in Evidence IV. Furthermore, page 1 of Evidence I indicates "DATE ISSUED 9/26/84", a date that is approximately 5 months earlier than the date of delivery of the materials to Rexham. It cannot, therefore, be reasonably concluded that the latter materials must have characteristics which are identical to those of the material manufactured according to Evidence I.

Furthermore, the conditions of the electrical discharge treatment disclosed on page 3 of Evidence I, i.e. *inter alia* 2.6 Amps and 50 fpm, do not allow to calculate the power of this treatment, nor is the relevant information in lines 3 to 7 of page 3 of document D10 of any help in this respect, since Mr Katz there states only that "not later than March 1, 1985 Kapton^(R) HN polyimide film was subjected to electrical discharge, commonly called corona treatment, which resulted in an increase in the adhesive and cohesive properties of the film."

In order to alleviate this deficiency, the

Appellant, in his submission dated 1 July 1994, page 1, item 1, presented a calculation, based on an electrical power of 13000 W (not mentioned in Evidence I itself), that led to a power of the treatment of 550 W·min/m². During the oral proceedings he corrected this result to 480 W·min/m². He did not provide any documentary evidence allowing to check the veracity of these calculations and results; instead the technical expert of the Appellant, Mr Katz, stated during the oral proceedings that the corrected result was obtained on the basis of information gained from the manufacturer of the corona discharge treating device.

From all that it must be concluded that the Appellant failed to convincingly demonstrate that the materials tested according to Evidence I were identical to those delivered to Rexham according to Evidences III and IV. In particular, there is no convincing proof for the Appellant's allegation that all Kapton HAN films commercialized by Du Pont at the relevant time had been corona treated in an identical fashion, i.e. in accordance with the treatment conditions set out in Evidence I. But even if, arguably, this would be accepted, the evidence presented by the Appellant in support of his contention that the electrical discharge treatment carried out according to Evidence I was in accordance with the conditions set out in the sole claim of the patent in suit would still be unconvincing. In view of the lack of relevant data concerning the power of the discharge treatment in Evidence I, the inconsistent character of the Appellant's statements concerning the missing power values and the lack of documentary evidence able to support any of these statements, Evidence I even

fails to prove that the treatment conditions set out therein led to films that met the corona discharge treatment requirement of the sole claim of the patent in suit.

The Board decides therefore that the Appellant's prior public use attack must fail, because the evidence adduced by him, in order to establish that the Kapton HAN films delivered to Rexham according to Evidences III and IV had the characteristics obtained by the corona discharge treatment at 20 to 500 W·min/m² required by the sole claim of the patent in suit, was insufficient.

In arriving at that conclusion the Board has not overlooked that

- (1) it has been sufficiently proved by Evidences I to IV that Kapton HAN films, which have been electrical discharge treated (but at an unknown power), had been delivered to Rexham,
- (2) the sole claim of the patent in suit is directed to a polyimide film, not to a method for its preparation, with the consequence that the power range of the corona discharge treatment delimits the scope of this claim only insofar as by that treatment the characteristics of the film are altered,

and that therefore

- (3) any electric discharge (or even other) treatment that causes the film to be altered in the same way as it is altered by the corona discharge treatment claimed according to the patent in suit would suffice to destroy the novelty of that feature.

However, the Appellant has not adduced any evidence on the basis of which it could be concluded with the certainty required (up to the hilt) that the Kapton HAN films delivered to Rexham according to Evidences III and IV had characteristics that were the same as those obtained by the corona discharge treatment specified in the sole claim of the patent in suit.

4. *Inventive step*

4.1 Technical field of the invention

The patent in suit relates to heat-resistant polyimide films, suitable as base films of flexible printed circuit boards, which films have improved, uniform adhesive properties, in particular to copper foil, and an improved runnability, without wrinkles and without blocking of the films when they are wound into rolls (page 2, lines 29 to 33; page 3, lines 20 to 23 and 40 to 42).

4.2 Document D7

This document relates to aromatic polyamide or polyimide base films for high density recording media which contain more than 0.03 weight percent but less than 5 weight percent of microparticles in the size

range of 5 μm to 500 μm (= 0.005 to 0.5 μm) which, at least on one side of the films, form microscopic protrusions of 30 to 500 Å high and 0.01 μm or higher diameter in the amount of 10^4 to 10^8 per mm^2 (cf. claim). In the penultimate paragraph of page 4 a large list of possible particles is disclosed, including SiO_2 and TiO_2 . According to page 7, last paragraph, before applying a magnetic layer, the films are preferably glow discharge or corona discharge treated.

According to Practical Example 3 (pages 11 and 12) a film was cast from a polyamide acid solution containing TiO_2 -particles of 30 μm (0.03 μm) diameter, which solution had been prepared from 4,4'-diaminodiphenylether and pyromellitic acid dianhydride. By heating up to 400°C the polyamide acid was converted to polyimide. The resulting film was glow treated in an Argon atmosphere of 10^{-2} torr and finally coated by vapor deposition with a Co-Ni alloy (cf. Practical Example 1, page 10, paragraph 4).

As set out on page 3, lines 5 to 8, it was an object of D7 to develop films having excellent surface and running properties as well as durability. The good running property, determined by observation of the picture disturbance of a VHS tape produced from the films (cf. page 9, lines 11 to 15), was provided by inclusion of microparticles which form protrusions that are able to improve the sliding properties. The good durability, i.e. good resistance against scratching and dropping of the magnetic layer of a VHS tape (cf. page 9, lines 16 to 21), was obtained by electrical discharge treatment, as can be concluded from the statement in the sentence bridging pages 7 and 8: "... , before applying a magnetic layer, glow discharge treatment or corona discharge treatment is preferably carried out as a pretreatment, and the durability is significantly improved from that ..."

4.3 Suitability of D7 as starting point for the assessment of inventive step

4.3.1 The subject-matter of the patent in suit and of document D7 both relate to metal coated, heat-resistant polyimide films, albeit for different uses (D7: flexible printed circuit boards; patent in suit: magnetic recording media). However, the claim of the patent in suit does not restrict the films to that specific use.

Both, the patent in suit and D7, strive for good runnability and good adhesive properties of the films. In both cases "good runnability" means low friction between the film and an exterior member and "good adhesive properties" means high bond strength between the film and a material attached thereto.

To achieve these properties again both subject-matters, that of the patent in suit and that of D7, apply the same measures: (a) reduction of the surface smoothness of the film by incorporation of protrusion-forming filler particles in order to improve the runnability, and (b) electrical discharge treatment of the film surface in order to enhance its adhesiveness.

Moreover, among the filler particles to be used according to D7 are SiO_2 and TiO_2 , i.e. fillers that are within the claimed scope of the patent in suit, and corona discharge treatment, i.e. the method to be used according to the patent in suit, is one out of only two options disclosed in D7.

Therefore, in the Board's judgment, D7 is an appropriate starting point for the person skilled in the art heading for an improvement in the technical field in which the present subject-matter is located (cf. Section 3.1 supra).

4.3.2 The above conclusion is not prejudiced

- (i) by the fact that the preferred uses of the films according to the patent in suit and according to D7 are different (flexible printed circuit boards as compared to high density recording media),
- (ii) by the different filler particle sizes used according to D7 and according to the patent in suit, and
- (iii) by the different materials to be adhered to the electrical discharge treated film surface according to D7 (metal coating, vapor deposited directly on the film surface) and according to the patent in suit (metal foil adhered to the film surface by the interaction of an intermediate layer of an epoxy/nylon adhesive: cf. page 3, lines 49 to 51 of the patent in suit).

None of these differences is related to the **basic principles** applied in both cases to the improvement of the two relevant properties, runnability and adhesiveness, namely the incorporation of a filler able to roughen the film surface and the electrical discharge treatment able to enhance the capacity of the film surface for adhesion.

In this situation it is irrelevant that, dependent upon the different uses of the metal coated films (cf. item (i) supra), the measures taken differ in their **degree** (different surface roughness and different type of adhesiveness).

4.4 Problem and solution

4.4.1 The subject-matter of the sole claim of the patent in suit differs from that of D7 in the selection of certain particles from the list disclosed in D7, in the selection of the corona discharge treatment as method of the electrical discharge treatment and in the definition of a power range of 20 to 500 W·min/m² for that treatment.

4.4.2 The problem underlying the patent in suit was the provision of particle filled, electrical discharge treated polyimide films, which, when bonded to a copper foil by an adhesive, provide a bond strength that is substantially enhanced, exceeding that normally achieved by electrical discharge treatment, to render the laminates suitable as base films of flexible printed circuit boards.

4.4.3 The bond strength and friction measurement data in Table 1 of the patent in suit demonstrate that the above-mentioned problem has been effectively solved by the claimed measures.

4.4.3.1 According to the examples in this table the bond strength of a polyimide film comprising 0.15 wt.% CaHPO₄ powder to a copper foil bonded thereto with an epoxy/nylon adhesive is improved by stepwise enhancement of the power of the corona discharge treatment to 300 W·min/m²:

corona discharge treatment	power [W·min/m ²]	bond strength [kg/cm]
no (Comp. Example 2)	0	0.8 - 1.0
yes (Comp. Example 4)	5	1.2 - 1.3
yes (Example 1)	20	1.7 - 1.9
yes (Example 5)	300	2.6 - 3.0

4.4.3.2 A comparison of the bond strength values reported for Comparative Examples 1 to 3 and Example 3 reveals that the bond strength improvement exceeds the expectations by far:

example No.	CaHPO ₄ 15 wt.%	corona treatment [W-min/cm ²]	mean bond strength [kg/cm]
Comp. Ex. 1	none	no	0.6
Comp. Ex. 2	yes	no	0.9
Comp. Ex. 3	none	100	1.2
Example 3	yes	100	2.5

From the above data it may be concluded that

- (i) the incorporation of CaHPO₄ **alone** enhances the bond strength by 0.3 kg/cm (= Comp. Ex. 2 minus Comp. Ex. 1),
- (ii) the corona discharge treatment **alone** enhances the bond strength by 0.6 kg/cm (= Comp. Ex. 3 minus Comp. Ex. 1),
- (iii) the bond strength improvement **to be expected** from the combination of (i) and (ii) was therefore 0.9 kg/cm (0.3 + 0.6); i.e. that the bond strength achieved by this combination of measures should be about 1.5 kg/cm.

However, the actual bond strength value reported for Example 3 is much higher: 2.5 kg/cm.

These data are even more significant if one considers the relative improvement instead of the absolute figures. In this case, the actual bond strength value is 66% higher than the expected value.

These data, thus, provide evidence for a **synergy**, with respect to the achieved bond strength, of the two a priori distinct measures: presence of CaHPO₄ particles and the corona discharge treatment.

4.5 Obviousness

4.5.1 While it was known from D7 that the adhesiveness of particle containing polyimide surfaces can be enhanced by electrical discharge treatment, this document is silent about the power of this treatment and does not quantify the bond strength that may be achieved. There is also no information in D7 concerning a possible dependence of the bond strength on the presence and/or type of particles comprised by the polyimide film. Even less does D7 suggest the possibility of a synergy, i.e. an increase of the improvement of the adhesiveness over and above the expectations of one skilled in the art by the combination of the measures taken according to the sole claim of the patent in suit, namely the incorporation of certain filler particles and the corona discharge treatment.

4.5.2 This synergistic improvement of the bond strength was unexpected to one skilled in the art. Its achievement was non-obvious within the meaning of Article 56 EPC.

D7 does not suggest that the combination of features specified in the sole claim of the patent in suit would give rise to the evidenced substantial rise of the bond strength and the person skilled in the art had, therefore, no reason to believe that he might be able to solve the existing problem by this combination of features.

The fact that it was known from D7 that a certain improvement of the adhesive properties of filled polyimide films can be obtained by electrical discharge treatment was certainly an incentive for someone seeking to benefit from the advantages known to be gained from such treatment. However, as evidenced by the Comparative Examples 1 and 3 (cf. 3.4.3.2 supra) the bond strength improvement to be expected was by about a factor of 2 (from 0.6 to 1.2 kg/cm), whereas the improvement evidenced according to Example 3 of the patent in suit is more than 4-fold (from 0.6 to 2.5 kg/cm).

There was no reason whatsoever for the expert to assume that the combination of the two measures, particle incorporation and corona discharge treatment, would be able to solve the existing problem. In particular D7 does not suggest any influence of the presence and/or type of particles on the adhesiveness of the films, an influence that is apparently necessary to create the synergistic effect.

4.5.3 This conclusion is not invalidated by the argument that the demonstrated synergistic improvement is a mere "bonus" effect unable to serve as evidence of an inventive effort.

It was held in T 192/82 (OJ EPO 1984, 415), that "the skilled man must be free to employ the best means already available for his purposes, although the use of means leading to some expected improvements may well be patentable if relying on an additional effect, provided this involves a choice from a multiplicity of possibilities", but that the lack of alternatives creates a "one-way-street" situation "leading to predictable advantages which remain obvious in spite of the existence of some unexpected "bonus" effect" (Reasons, Section 16).

These conclusions are not applicable to the present case for several reasons. First, the means (synergy between particles and corona treatment) to achieve the desired improvements (here: high degree of adhesiveness) was not available from the state of the art, secondly, the improvements could not be expected from the state of the art and, thirdly, there was no "one-way-street" situation; rather there were several alternatives in order to influence the adhesiveness, two of which (alkali treatment, sandblasting) are even identified in the patent in suit (page 2, lines 12 to 14).

The further possible argument that the synergistic effect was without consequence for the assessment of inventive step in a situation where it was the inevitable result of prima facie obvious measures (particle introduction and electrical discharge treatment) is also not conclusive here. The solution of the existing technical problem (cf. Section 4.4.2 supra) required a **combination** a measures (cf. Section 4.4.1 supra) that was not suggested by D7 in such a manner that it **would** have been adopted by the person skilled in the art. Therefore, and also because, as set out above, for the solution to the existing problem the person skilled in the art was not in a "one-way-situation", the conclusion made in T 69/83 (OJ EPO 1984, 357) does not apply (cf. T 69/83, last sentence of Section 6: "... the combination claimed ..., ... even if unexpected ... would still suggest itself to a person skilled in the art acting routinely ...").

4.5.4 Nor is the conclusion drawn in Section 4.5.2 supra affected by the Appellant's doubts as to the existence of a substantial improvement of the bond strength.

4.5.4.1 In particular, the Appellant's argument, that the bond strength evidenced for Example 3 of Table 1 of the patent in suit was not surprisingly superior to the expected value, cannot be accepted. This reasoning, which was based on the contention that the (low) bond strength value set out for Comparative Example 3 of this Table 1 was not a fair comparative basis, because this (low) value was caused by the presence on the film surface of a deposit of decomposition product, is not backed by any evidence. Such evidence, e.g. experiments demonstrating the influence of a deposit on the adhesive properties of the corona treated film, should have been provided by the Appellant in order to substantiate his assertion. Otherwise, his respective contentions are nothing more than unfounded allegations.

4.5.4.2 Similarly, the bond strength results submitted by the Appellant with his letter dated 30 April 1997 (Table 1 on page 4 and Table 2 on page 5, the latter table comprising a summary of data already submitted with letter of 7 June 1994), do not provide a reliable basis for the conclusion that the results in Table 1 of the patent in suit, that demonstrate a synergistic improvement of the bond strength, are wrong.

While it is true that, according to these Tables 1 and 2, the bond improvements obtained by the corona discharge treatment of CaHPO_4 filled films (Kapton HN treated to Kapton HAN) are not larger than those improvements obtained by the corona discharge treatment of unfilled films (Kapton H treated to Kapton HA), these data do not allow to conclude with certainty that there is no synergy between the filler and the corona discharge treatment, i.a. because the tested samples have been derived from different roll numbers ("Roll #"). It was admitted by the Appellant during the oral proceedings, and this is supported by

the results of the first two pairs of samples reported in Table 1 of Appellant's letter dated 30 April 1997, that the adhesive properties of films of different roll numbers may differ to some extent. Consequently, the comparison of bond strength improvements, which have been obtained by corona discharge treatment of samples from films of different roll numbers, is not straightforward. However, the roll numbers of the Kapton H and HN films tested according to Tables 1 and 2 of Appellant's letter dated 30 April 1997 are different and there is no information from which it could be concluded with sufficient certainty what the impact of the different provenance of the samples on the bond strength improvement by corona discharge treatment was.

Moreover, these Tables 1 and 2 do not contain any data from which the bond strength improvement caused by the incorporation into the film material of filler particles **alone** could be inferred, which improvement would normally be necessary to calculate the existence of an unexpected increase of the bond strength caused by both measures, the filler incorporation **and** the corona discharge treatment.

Even less relevant are the results contained in the Table on page 9 of the Statement of Grounds of Appeal, because therein the adhesive properties of films are compared which have been corona discharge treated at quite different powers (413, 215 and 135 W·min/m²). This comparison is meaningless in view of the important influence of the power of the corona discharge treatment on the bond strength (cf. Table 1, Comparative Example 4 and Examples 1 to 6 of the patent in suit).

In view of this situation the results of the experiments summarized in Tables 1 and 2 of Appellant's letter dated 30 April 1997, as well as of the experiments reported in the Statement of Grounds of Appeal are not able to disprove the correctness of the results in Table 1 of the patent in suit, which represent evidence for the existence of a synergistic effect on the bond strength of polyimide films containing certain filler particles and having been corona discharge treated within a certain power range.

- 4.5.5 The further state of the art in these proceedings is completely silent on the influence which the presence of filler particles in plastics materials may have on the adhesive properties of electrical discharge treated films made thereof. This prior art is therefore irrelevant for the purpose of assessing the obviousness of the present subject-matter, which is especially concerned with this effect.

This is particularly true for document D4 which relates, for the purpose of enhancing their adhesiveness to i.a. printing inks and vapor-deposited metals, to the corona discharge treatment of plastic materials, e.g. polyimides, in an atmosphere of nitrogen and carbon dioxide, but which does not contemplate the presence of filler particles (cf. Claims 1 and 7; column 1, line 67 to column 2, line 21).

- 4.5.6 The subject-matter of the sole claim of the patent in suit is also not obvious when starting from the assumption that the closest prior art was represented by the Kapton HN polyimide films, which, according to document D8, have been commercialized by Du Pont early in the 1980's. While one might argue that it was obvious to improve the adhesiveness of such films by corona discharge treatment, as taught in D7 and D4,

the skilled person had no reason to expect from such a treatment the surprisingly enhanced bond strength values evidenced in Table 1 of the patent in suit. Therefore, on the basis of this unexpected synergistic effect, an inventive step has to be recognized in the subject-matter of the patent in suit as granted.

4.5.7 The Appellant, therefore, did not succeed to convincingly demonstrate that the subject-matter of the sole claim of the patent in suit as granted was obvious over the cited prior art, particularly over the disclosure of document D7.

5. Thus, in spite of the introduction of D7 into the appeal proceedings, the patent in suit is to be maintained unamended in accordance with the Respondent's main request. Under these circumstances and given the Board's discretion under Article 111(1), second sentence of the EPC, the Respondent's request that, in the event that the Board decided to introduce D7 into the appeal proceedings, the case be remitted to the first instance and that the Appellant be ordered to bear the costs for a resumption of the first instance proceedings, had not to be considered.

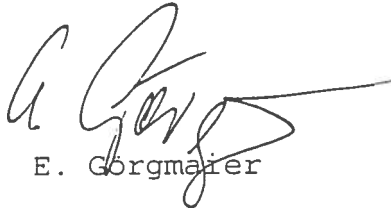
Since the patent in suit is maintained unamended, the Respondent's auxiliary request had not to be examined either.

Order

For these reasons it is decided that:

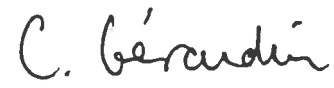
The appeal is dismissed.

The Registrar:



E. Gorgmaier

The Chairman:



C. Gérardin