Market of Polyimide film

- Application and required properties –

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1) Background

Polyimide resin is widely used by several forms such as varnish, molding, fiber and film so on. In this manuscript I describe the application and required properties about Polyimide film which is most used industrially.

2) Market of Polyimide film

Polyimide film has been used for various industrial areas, especially electrical & insulation application due to its high reliability of non-conductance, ultra-heat/cold-resistance, mechanical strength, chemical resistance and radioactive rays-resistance.

A. Electrical application

Polyimide film is used as the base material of Flexible Printed Circuit (FPC), Tape Automated Bonding (TAB) and Chip On Film (COF). Flexible Copper Clad Laminate (FCCL) and Coverlay (CL) are used as base materials for these applications.

FPC: Mainly used as a circuit in electrical apparatus such as Mobile Phone, HDD and Digital Camera etc. due to its thinness, flexibility and lightness. (Pic. 1-5)

FPC demand decreased dramatically in 2009 due to the economic crisis, however over 10% annual growth is expected in the future. (Table 1)

TAB: Mainly used as a tape substrate for Chip Scale Packaging (CSP) and Ball Grid Array (BGA), LCD, PDP, DRAM and Printer. (Pic.6,8)

COF: Mainly used as a tape substrate with driver IC for LCD. (Pic.7,8)

After COF was developed, COF demand is rapidly increasing instead of TAB decrease in large-scale LCD. (Table 2)

B. Insulation application: Polyimide film is used as insulation tapes for magnet wire and cables of Aircraft and Locomotive. (Pic. 9)

C. Other applications: Polyimide film is used in satellite, super conductive equipment, oil pump, Pressure Sensitive Tape (PST) and barcode label.

3) FCCL

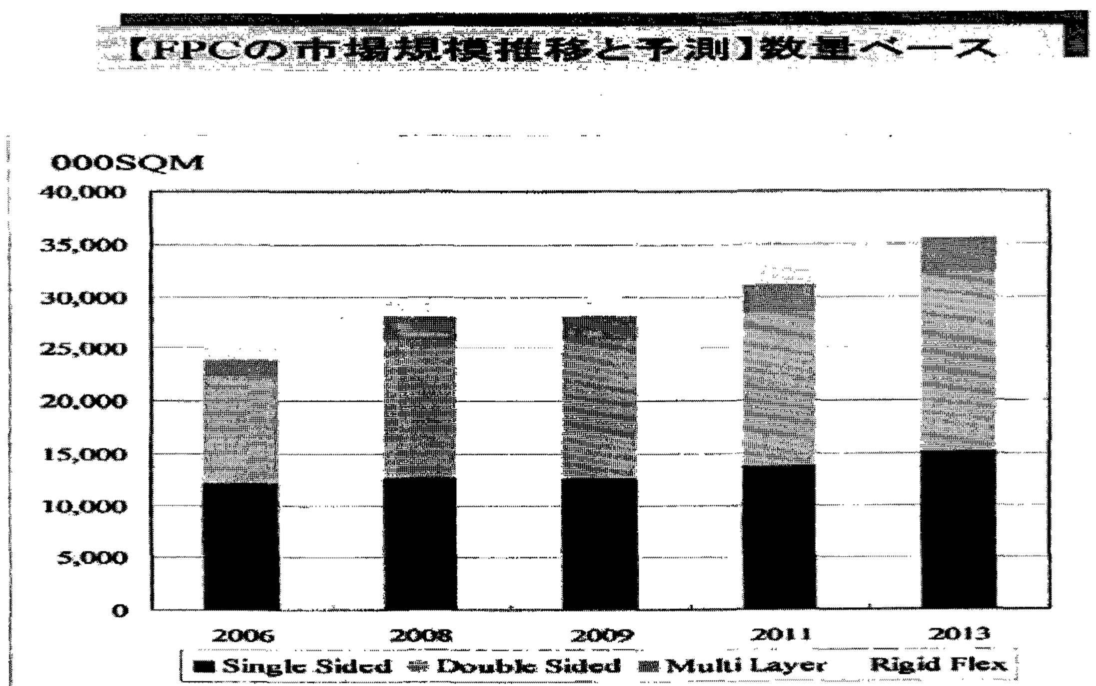
FPC is produced from FCCL and CL. FCCL and CL is a biggest application for Polyimide film. There are several types of FCCL. (P.5)

1. Lamination of Polyimide film with thermosetting adhesive and Copper foil, called 3 layer FCCL
2. Lamination of Polyimide film with thermoplastic Polyimide and Copper foil, called laminate 2 layer FCCL
3. Casting Polyimide resin or precursor on Copper foil, called casting 2 layer FCCL
4. Sputtering Cu on Polyimide film, called sputtering 2 layer FCCL

Recently usage of 2 layer FCCL is increasing because of higher demand for electrical reliability, heat-resistance, dimensional stability and flexibility as severe demands such as high density and high functioning are strongly requested.

There are also several types of CL, such as Polyimide film with thermosetting adhesive, liquid type and photosensitive type.
In FPC application, required properties for Polyimide film are thinner thickness, flexibility and dimensional stability.

Table1. Market trend of FPC

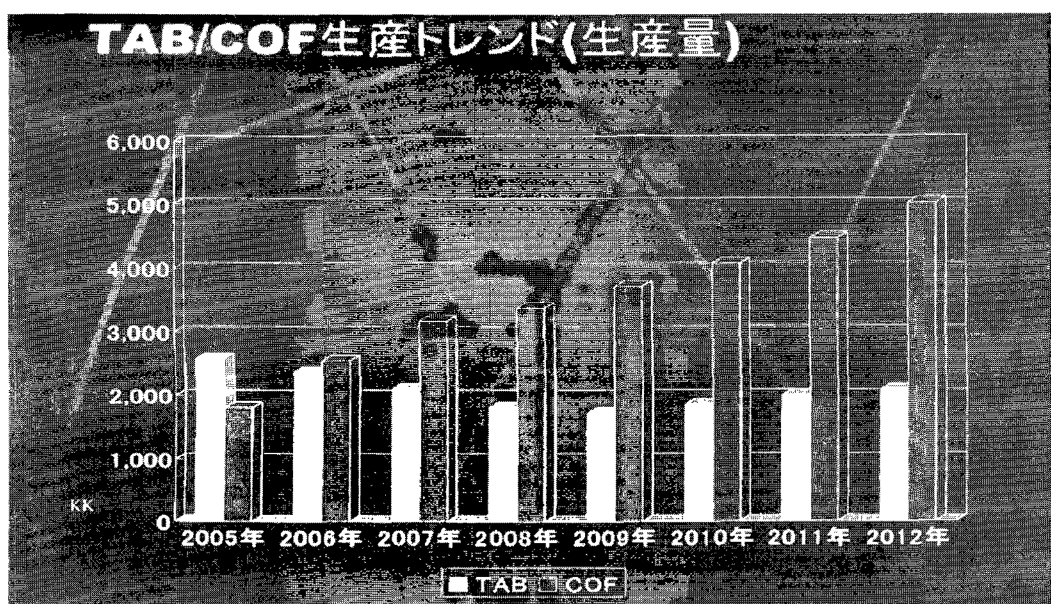


Source : JMS FCCL Report 2009

4) TAB/COF application

TAB and COF are tape substrates with sprocket hole. 3 layer FCCL is used for TAB and PVD type 2 layer FCCL is used for COF. Liquid type is used for CL in these applications.
Main markets for these tape substrates are Flat Panel Display (FPD) and Package.
Required properties for Polyimide film in this application are hardness, no-curl and dimensional stability because IC is mounted on these substrate.

Table 2. Production volume of TAB/COF

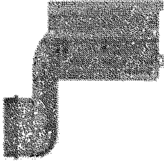


Source : NetBrain Corporation
TAB/COF マーケット アプリケーション需要分析 2009

5) Insulation application

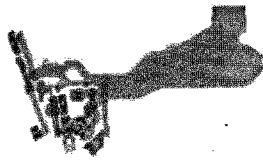
Polyimide film with fluorocarbon is cut to a tape and rapped around magnet wire and cable fitted into Aircraft and Locomotive motors. Main markets are western countries, China, India and Russia. In this application, several properties are newly requested such as arc-tracking resistance, cut-through resistance and corona resistance. Total demand in this market is over 400t/Y.

Pic.1 Typical FPC



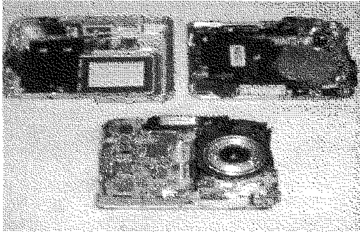
(Fujikura HP)

Pic.2 Typical FPC

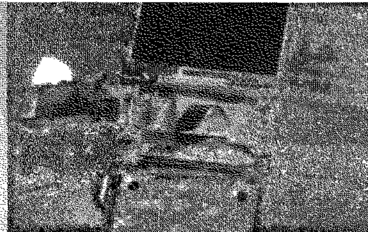


(Fujikura HP)

Pic.3 FPC in Digital camera



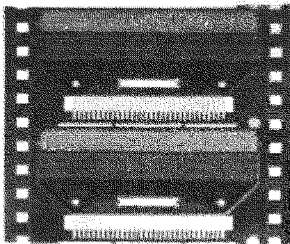
Pic.4 FPC in Mobile Phone



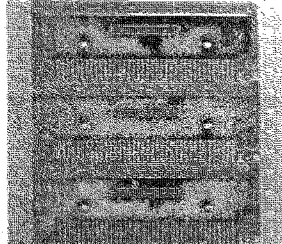
Pic.5 FPC in HDD

(www.onaosi-navi.com) (Design Wave Magazine 2006 July)

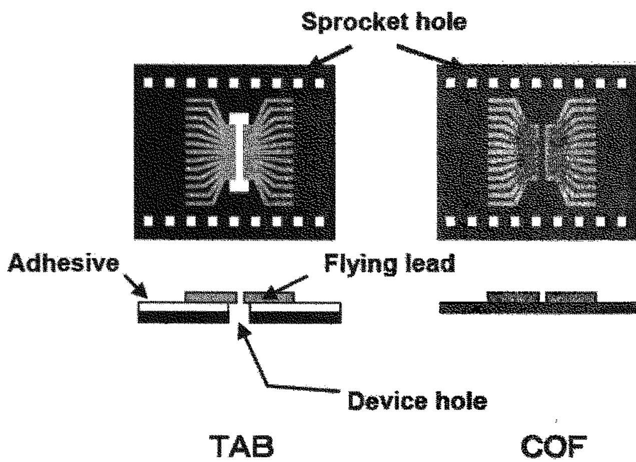
Pic.6 TAB



Pic.7 COF

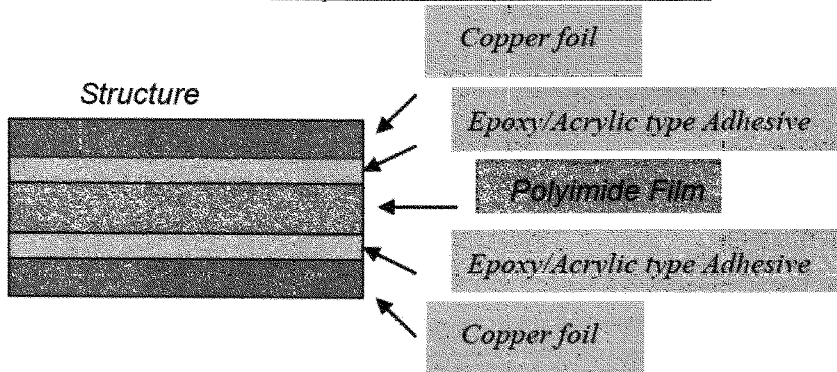


Pic.8 Structure of TAB/COF

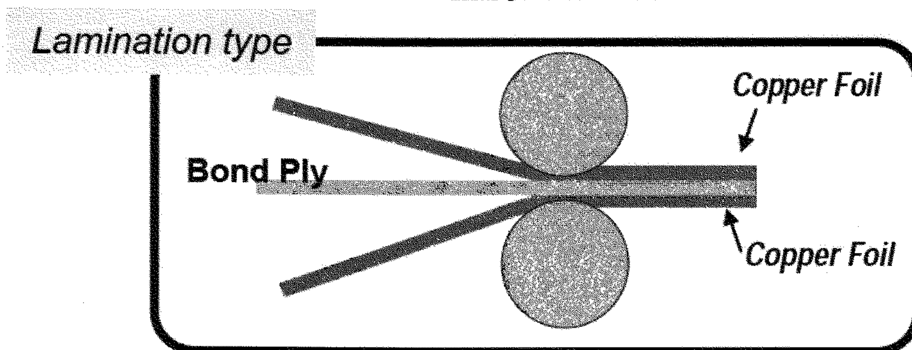


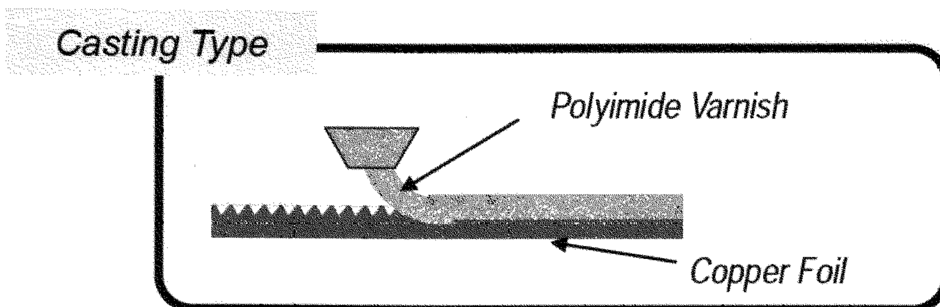
* L/S is limited in TAB due to Flying lead.

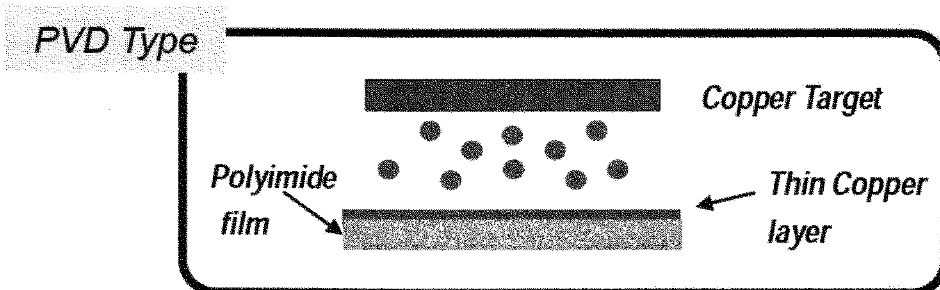
3 layer FCCL (Double sided)



2 layer FCCL







Pic.9 Wire insulation

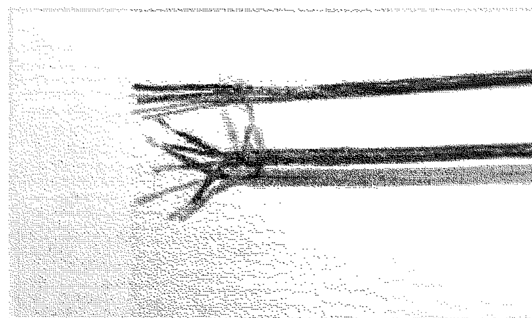


Table3. Comparison data of Polyimide films

	Unit	Apical 25NPI	Kapton 100V	Upilex 75S	Kapton 150EN	Test condition	Test method
Tensile Modulus	GPa	4.0	3.4	6.9	5.8	20℃	ASTM D882
Tensile Strength	MPa	320	340	360	380	20℃	ASTM D882
Elongation	%	80	82	50	60	20℃	ASTM D882
CTE	ppm	16	27	20	16	50~ 200℃	TMA
Main Thickness	μm	12.5 25	12.5 25	75 50	38	—	—
Main application	—	FPC	FPC Insulation	TAB	COF	—	—

Data from each company's catalogue

(continuing fromp87)

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3. (i) Wang F, Zhang J, Huang J X, Yan H, Huang F R , and Du L. *Polymer Bulletin,* 2006, *56, 19;* (ii) Wang F, Xu J F, Zhang J, Huang F R , Shen YJ and Du L. *Polymer International,* 2006, 55: 1063.
4. Zhang L, Gao F, Wang C F, Zhang J, Huang F R, and Du L. *Chinese Journal of Polymer Science*， 2010， 28 (2)：199.
5. (i) Gao F, Zhang L L, Huang F R， Tang L N, Zhang J, Zhou Y,and Du L. *Bull. Korean Chem. Soc.,* 2010, 31(4): 976；(ii) Gao F, Zhang L L, Huang F R and Du L. *Chinese Chemical Letters* ，2010, 21:738；(iii) Gao F, Zhang L L, Zhou Y, Huang F R and Du L. *Journal of Macromolecular Science, Part A,* 2010, 47(8): 861.