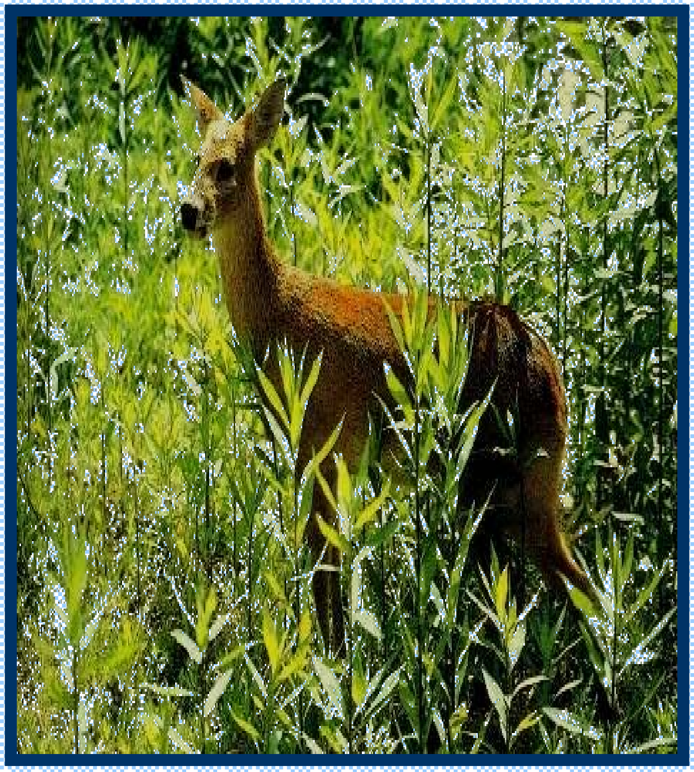
Suede Made from Superfine Fiber Blend-spun via PA6/PE and Its Applications



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1. Technology Process

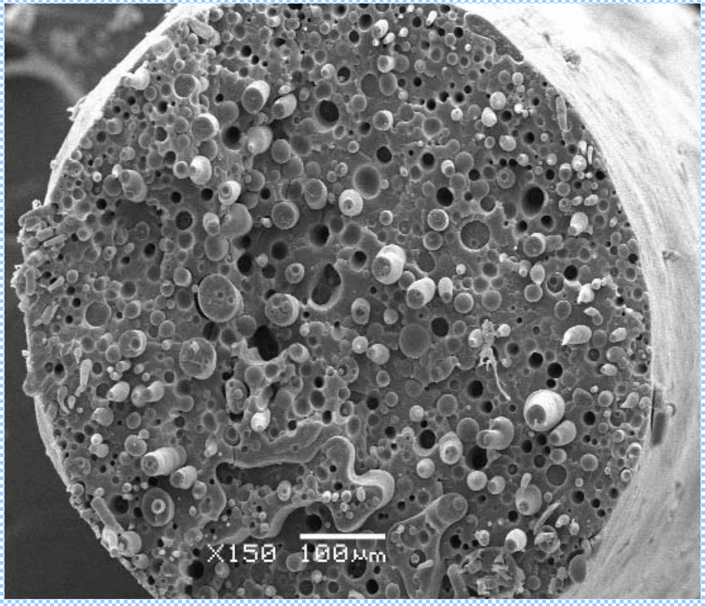
PA6
LDPE
compatibilizer

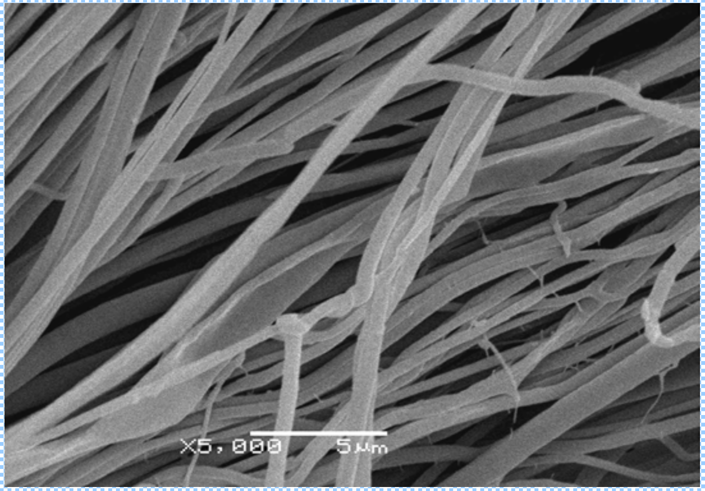
melt blend
spinning

matrix-fibril blend fiber

extracting PE
with solvent

PA6 Superfine fiber

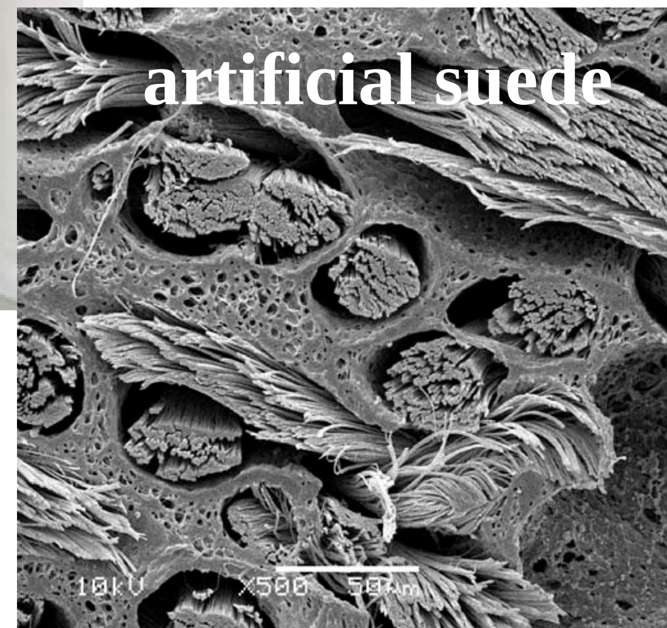




by carded, laminated and needle-punched

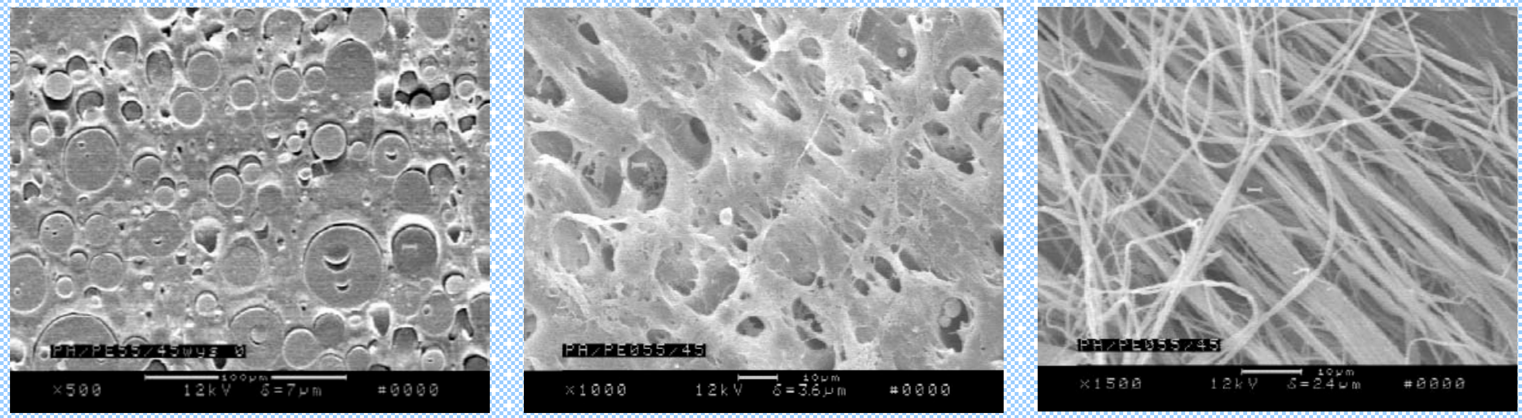
by impregnated, pressed, solidified , extracted

and buffed, dyed …



2. Morphology Structure Controlling of the Blend Fiber

2.1 Morphology Structure of PA6/PE Blend fibers

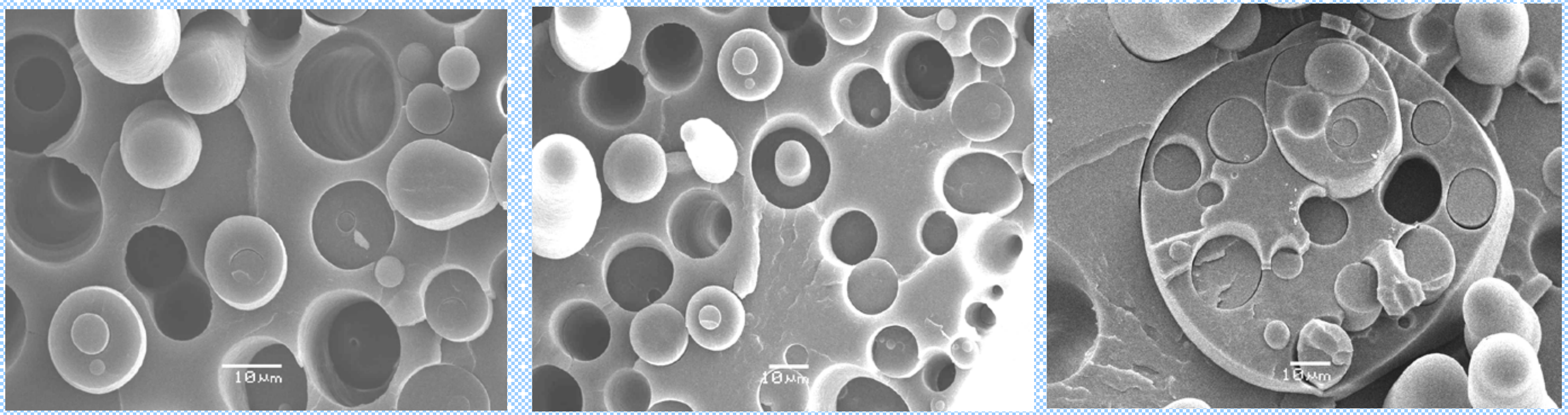


a (×500) **b (×1000)** **c (×1500)**

Fig.1 Morphology Structure of Blend Fibers

a: original, b: treated by formic acid, c: dissolved by xylene

2.2 Morphology Structures of the Blend Fibers with Different Viscosity Ratios



a (6.15)　　b(4.72)　　c(2.67)

Fig. 3 Cross-section of Blend Fibers with Three Different Viscosity Ratios of PA6/PE

2.3 The Effect of Composition Ratio of PA to PE on Morphology Structure of the Blend Fibers

For the lowest viscosity ratio (1.87), all the blend fibers can not be splitted into ultra-fine fibers .

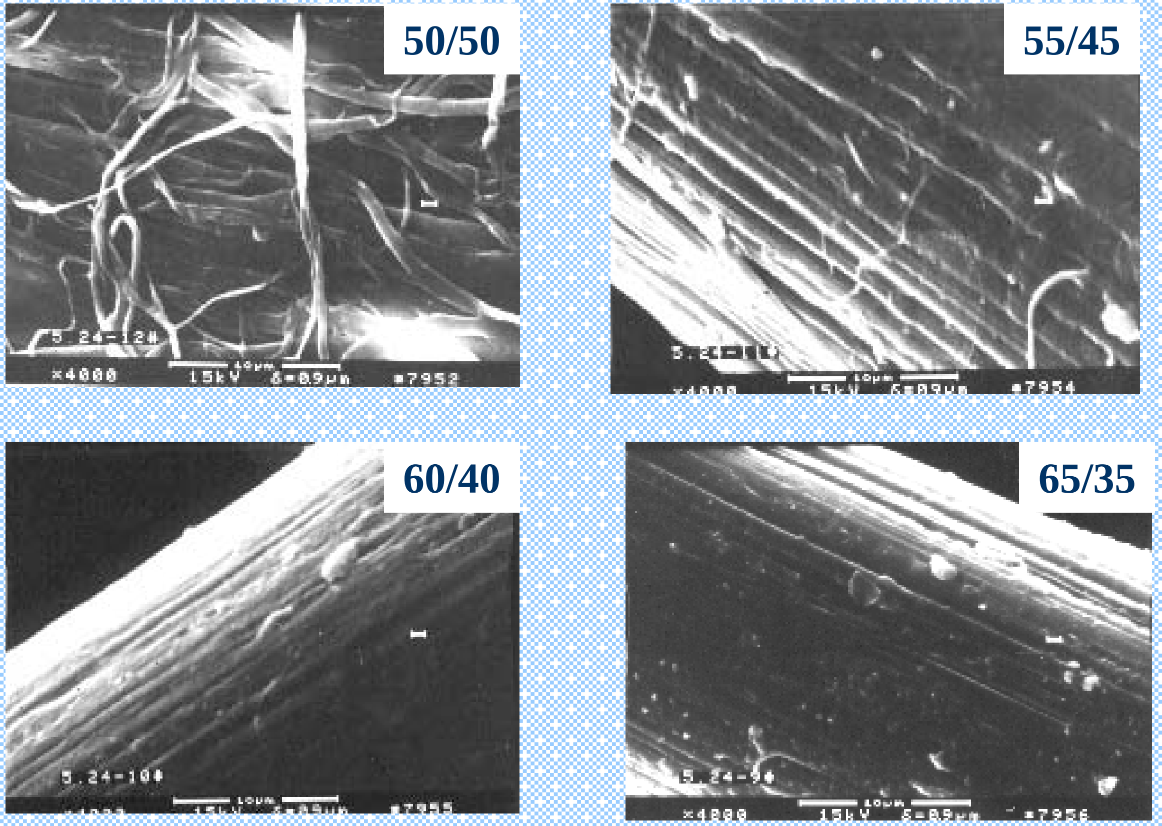


Fig.4 Morphology Structure of Blend Fiber After Treatment with Xylene.

(η_m(PA6) /η_m(PE) = 1.87)

For the second lowest viscosity ratio (3.72), the blend fiber can be splitted into ultra-fine fiber except with the blend ratio of 65/35(PA/PE).

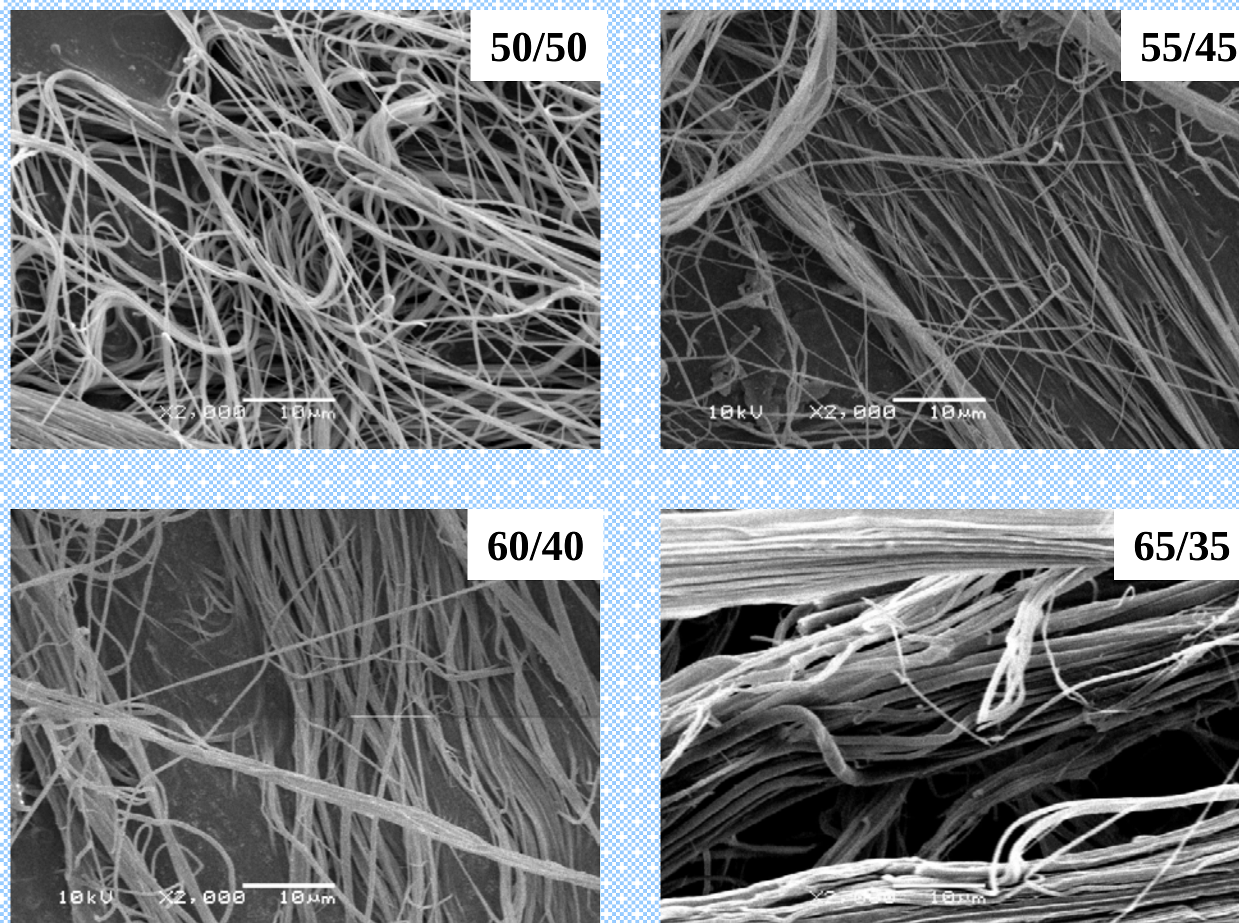


Fig. 5 Morphological Structure of Blend Fiber After Splitting

(η_m(PA6) /η_m(PE) = 3.72)

For the highest viscosity ratio (PA6/PE=6.15), all the blend fibers with composition ratios from 65/35 to 50/50 can be splitted into super-fine fibers

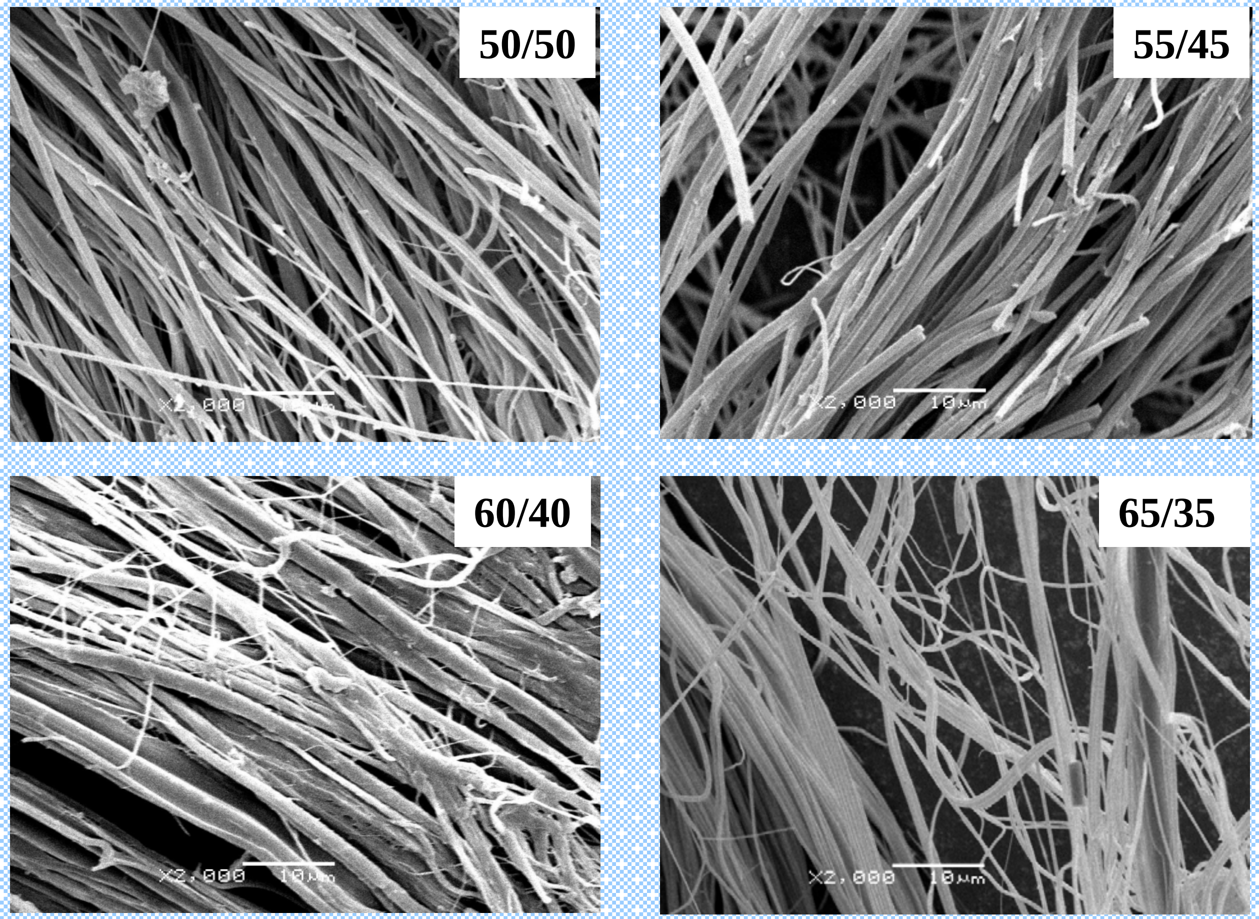


Fig.6 Morphological Structure of Blend Fiber After Stripping

（ηm(PA6) /ηm(PE) = 6.15）

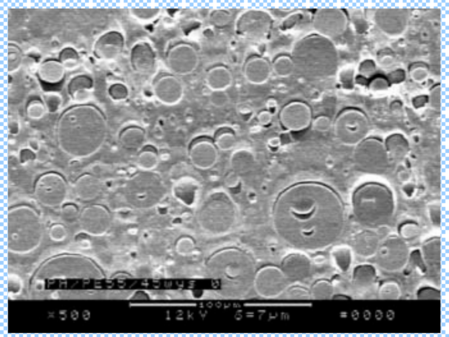
Table1. Evaluation of the stripping efficiency as a function of viscosity and composition ratio

ηm(PA6)/ηm(PE)	Blend ratio of PA6/PE			
	65/35	60/40	55/45	50/50
1.87	×	×	×	∨
2.50	×	×	∨	∨
2.67	×	∨	∨	∨
3.58	∨	∨	∨	∨
4.29	∨	∨	∨	∨
4.72	∨	∨	∨	∨
5.14	∨	∨	∨	∨
5.66	∨	∨	∨	∨
6.15	∨	∨	∨	∨

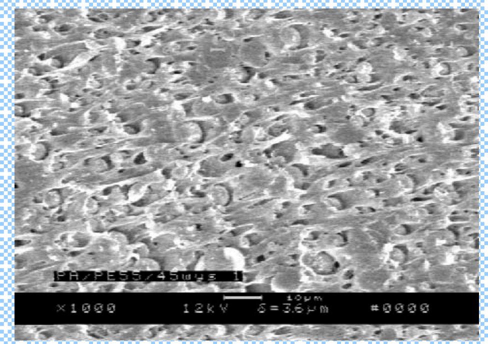
Note: ∨ indicates the fiber can be stripped.
× indicates the fiber can't be stripped.

3. Morphology Structure Controlling for PA6/PE Blend Fiber by Adding Compatibilizers

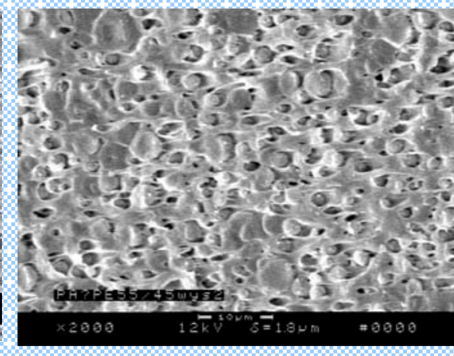
3.1 Change of Morphology Structures of Blend Fibers by Adding Compatibilizer



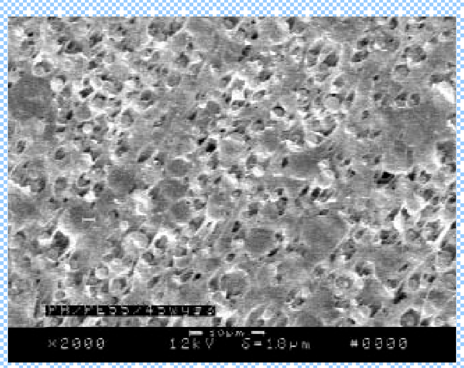
a(×500)



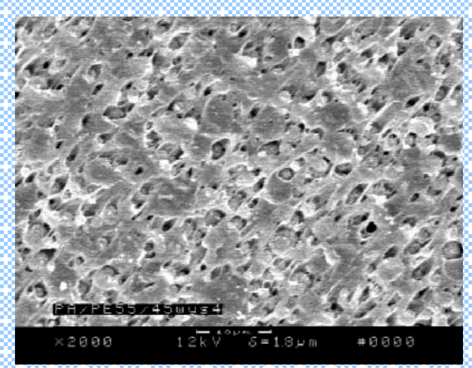
b (×1000)



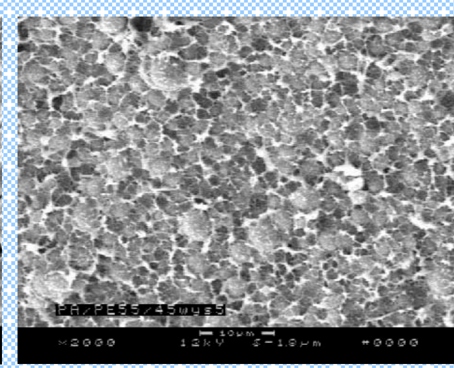
c (×2000)



d(×2000)



e(×2000)

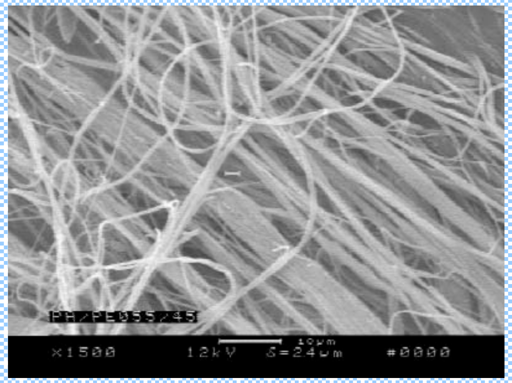


f(×2000)

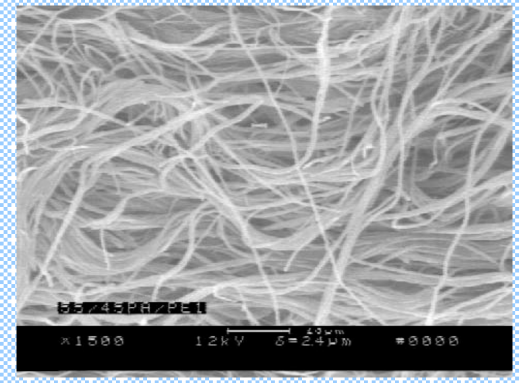
Fig.7 SEM-photos of Cross-sections of blend fibers with different amount of compatibilizers

a: 0; b: 1%; c: 2%; d: 3%; e: 4%; f: 5%

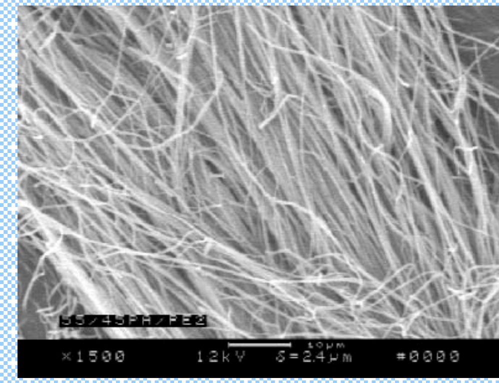
3. 3 Morphology Structure of Blend Fibers After Dissolving Splitting



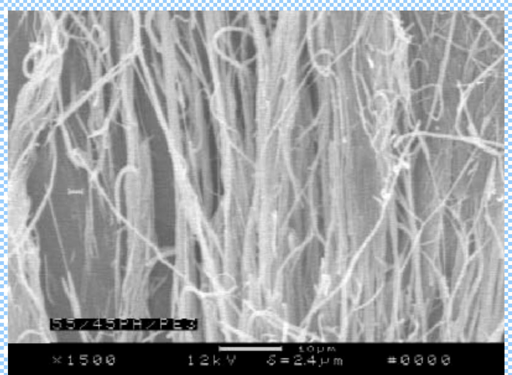
a (×1500)



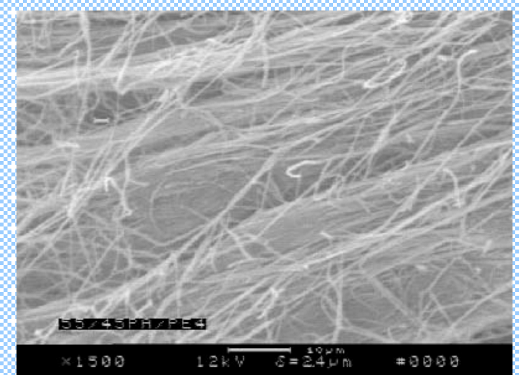
b (×1500)



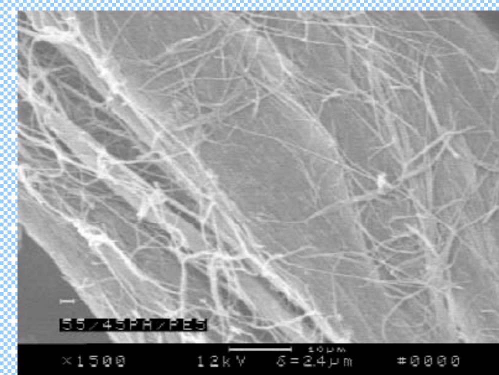
c (×1500)



d (×1500)



e (×1500)



f (×1500)

Fig. 8 SEM-photos of Longitudinal Surface of Blend Fibers Dissolved by Xylene With Compatibilizer of Different adding amount (×1500)

a: 0; b: 1%; c: 2%; d: 3%; e: 4%; f: 5%

The morphology structures of suede and chamois leather

Fig.9 SEM Micrograph of artificial Suede

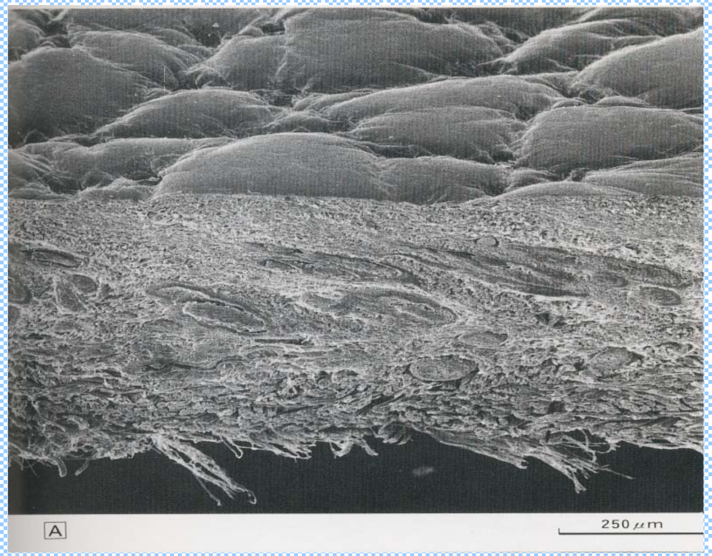


Fig.10 SEM Micrograph of Chamois Leather

4. Properties of Leather

and

Artificial Suede

Table2 Moisture Permeability

Sample	Leather	Artificial Suede
Thickness(mm)	1.695	1.664
Moisture Permeability ($g.m^{-2}.h^{-1}$)	30.0	28.9
Moisture Permeability per unit thickness ($g.m^{-2}.h^{-1}.mm^{-1}$)	17.70	17.38

Table3 Air Permeability

Sample	Leather	Artificial Suede
Thickness(mm)	1.695	1.664
Mass per unit area ($g.m^{-2}$)	510	560
Air Permeability （$mm.s^{-1}$）	10.3	12.7

Table 4 Mechanical Properties

Sample	Leather	Artificial Suede
Breaking Strength(N)	799	857
Breaking Elongation(%)	39.46	46.09
Breaking Power (J)	99.20	41.50
Breaking Time(s)	39.44	27.66
Maximum Tearing Force (N)	59.60	69.00
Minimum Tearing Force (N)	35.10	54.00
Average Tearing Force (N)	47.20	60.90

5. Applications of Nonwoven and Artificial Suede

Garments and Bags

- soft touch
- natural leather feel and appearance.
- change color effects
- good sense level
- fine embossing
- printing performance
- high peel strength
- abrasion resistance

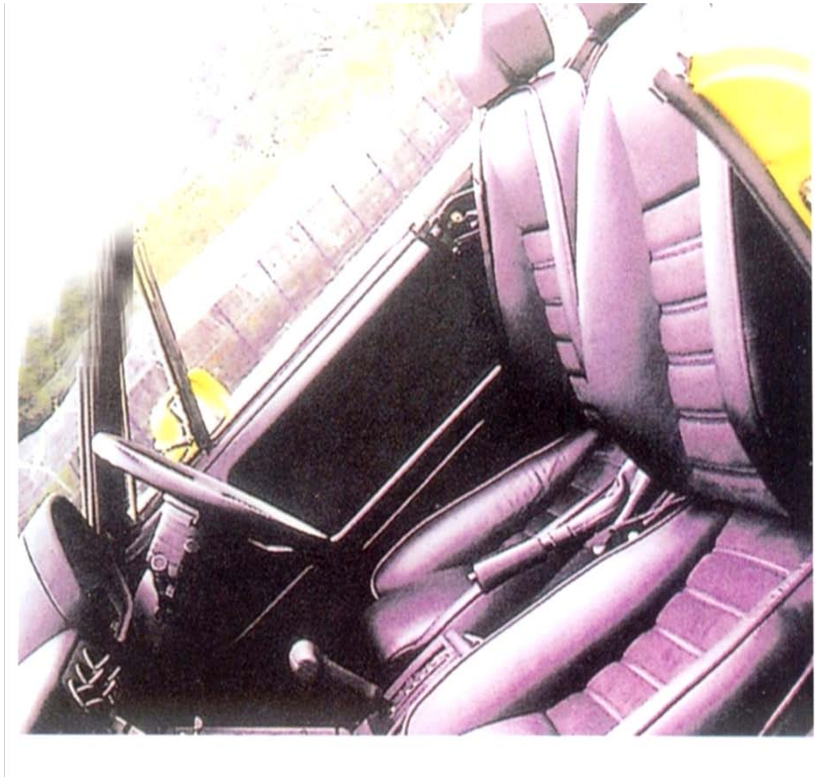
Gloves

- abrasion resistance
- anti-bacteria
- prevent bore
- flame retardant

Cases

- high mechanical properties
- textural clarity
- color and diverse
- natural leather appearance.

Car decorations



- environmental performance
- flame-retardant
- high mechanical properties
- anti-aging

SHOES

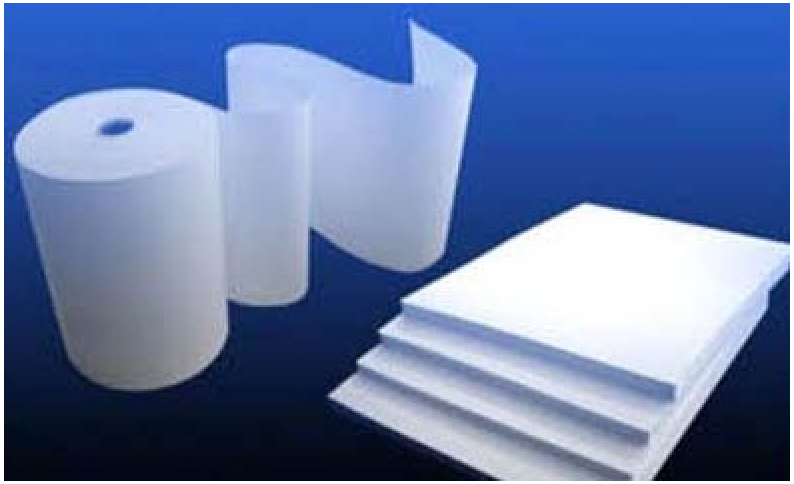
- high moisture permeability
- waterproof
- anti-bacteria
- anti-wrinkling
- high peeling strength
- high tensile strength
- high tearing strength

Medical uses

- waterproof
- moisture-permeability
- anti-bacteria
- high strength

Industrial filters

- high overall uniformity of material properties
- high filtration efficiency
- low resistance
- high strength



Ball

- feel good
- wear resistance
- low water absorption,
- appropriate toughness
- flexibility
- quality of light.

wiping cloth

- adsorption strong
- absorbent and soft
- not to hurt the surface
- reusable

6. Conclusions

(1) The blend fiber with two-phases structure is obtained by melt blend spinning of PA6 and PE. In order to make PA6 for disperse phase even at higher composition ratio, the viscosity ratio of PA6 to PE should be well controlled.

(2) By changing the amount of compatibilizer in the blends, the spinnability can be improved, and the island’s diameters can become smaller and more uniform. However, too much compatibilizers will lead to the difficulty in splitting process.

(3) The nonwoven and suede manufactured by the superfine fiber have enough tackiness and soft touch, good permeability, higher strength and rub resistance etc.

They are widely used for making sporting gloves, sporting shoes, footballs, basketballs, bags, car and sofa coverings, clothes, medical as well as industrial filter materials, etc. In the future , they will have more potential applications.

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