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Innovative SEBS for overmolding application

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Asahi KASEI Corporation

TPO conference, 29 Sept- 1 October 2025, Troy, Michigan

Presentation outline

- ✓ **Company overview and our SEBS (TUFTEC™ and S.O.E.™)**
- ✓ **TPU and MAH-SEBS alternatives for overmolding**
  - **-Solution1. Non-functionalized high styrene SEBS**
  - **-Solution2. Amine functionalized SEBS**
- ✓ **Summary**

Corporate profile

Trade name	Asahi Kasei Corp.
Founding	May 25, 1922
Head Office	Tokyo, Japan
Paid-in capital	¥103,389 million
Employees	50,352

(consolidated, as of March 31, 2025)

Management configuration

Asahi Kasei Corp. (Holding company function)

MATERIAL sector

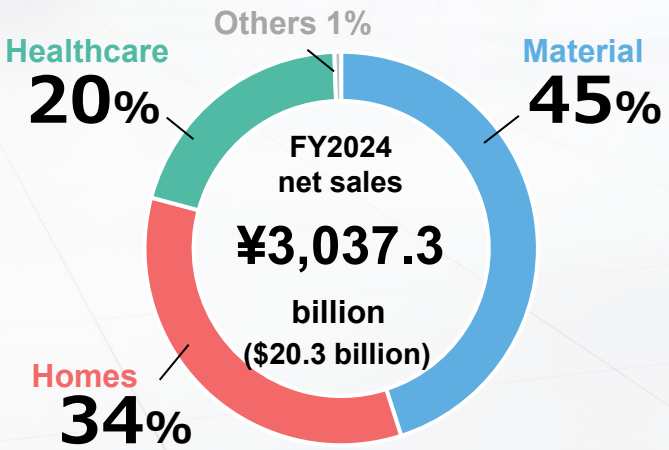
- Asahi Kasei Corp. (operating function)
- Asahi Kasei Microdevices Corp.
  - Electronics
  - Car Interior
  - Energy & Infrastructure
  - Comfort Life
  - Chemical

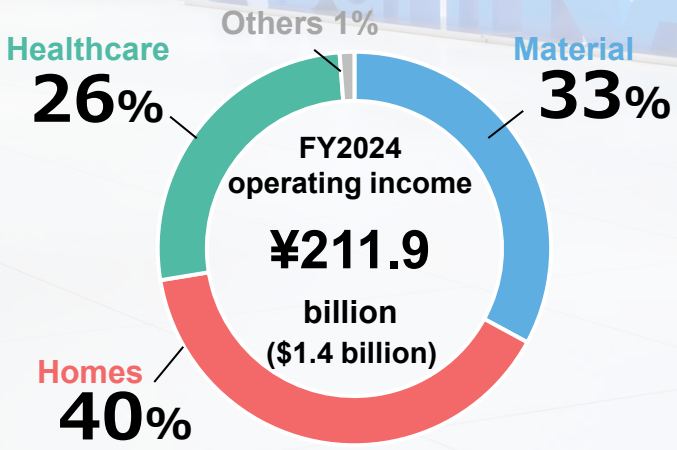
HOMES sector

- Asahi Kasei Homes Corp.
  - Housing
- Asahi Kasei Construction Materials Corp.
  - Construction Materials

HEALTH CARE sector

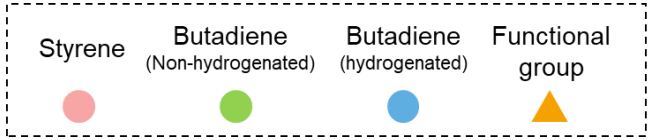
- Asahi Kasei Pharma Corp.
  - Veloxis Pharmaceuticals, Inc.
  - Pharmaceuticals
- Asahi Kasei Life Science Corp.
  - Life Science
- ZOLL Medical Corporation
  - Critical Care





(Percentages excluding corporate expenses and eliminations)

Our SEBS structure



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Creative unique structure of soft block can lead to success.

TUFTEC™

Homo-polymer type

H-series : Complete hydrogenation

P-series : Selective hydrogenation

M-series : Functionalization(chain/end)

MAH-SEBS

Amine-SEBS

- ✓ Function as modifier by imparting impact resistance, elasticity or as compatibilizer between several resins.
- ✓ Compatible with wide variety of resin such as PP , PS, PA, TPU.
- ✓ Weatherability and heat resistance

S.O.E.™

Co-polymer type

Main topic

Tg at room temp. / High SP value

High styrene -SEBS

- ✓ Abrasion/Scratch resistance
- ✓ Damping property
- ✓ Compatible with filler and polar resin
- ✓ Soft-touch feeling haptic

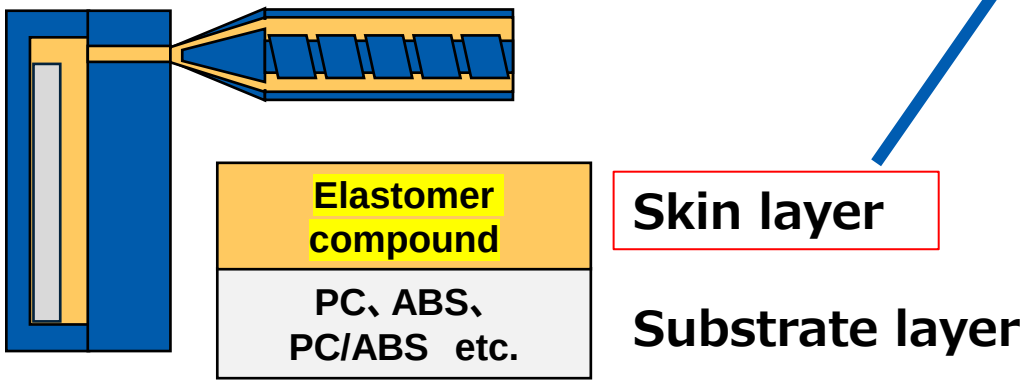
Overmolding

■ Application

Automotive interior skin

- Console box
- Assist grip
- Handle
- Shift lever
- Door trim panel

Molding image(ex. Console box)



■ Required properties

- ✓ Soft touch feeling (Flexibility)
- ✓ Stylish design (Processability)
- ✓ Adhesion to polar substrates

Existing solution

TPU + MAH-SEBS

-based compound

Issues of existing solution

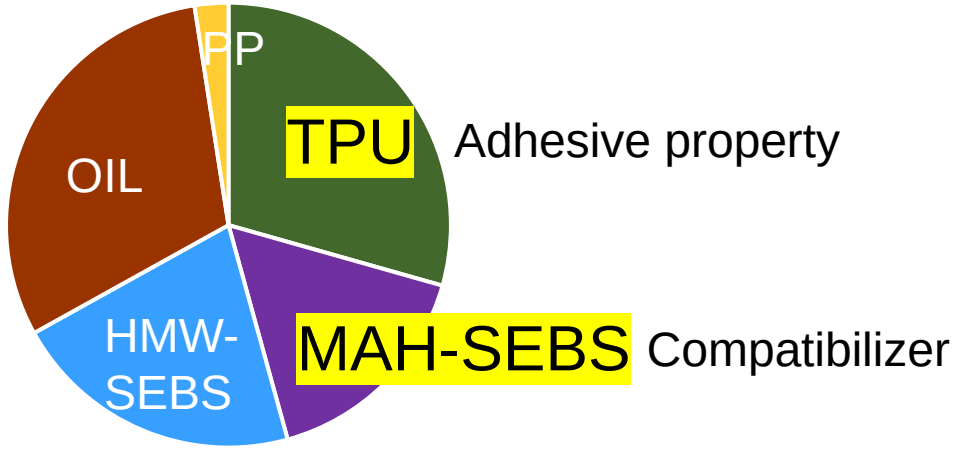
■ Features

- ✓ Soft touch feeling (Flexibility)
- ✓ Adhesion to polar substrates

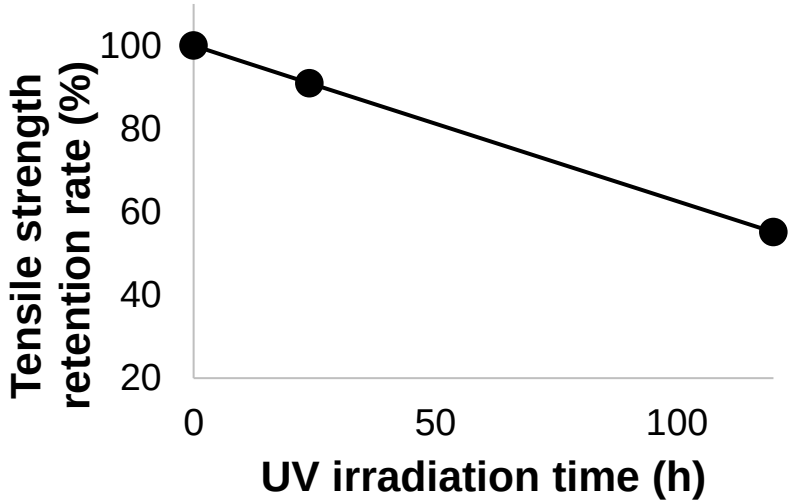
■ Concerned issues

- ✓ High material cost (TPU, MAH-SEBS)
- ✓ Yellowing (TPU, MAH-SEBS)
- ✓ Poor UV-resistance (TPU)
- ✓ Hydrolysis (TPU)
- ✓ High specific gravity (TPU)
- ✓ Maleic acid residue (MAH-SEBS)

Formulation



UV aging test of neat TPU



Sample after aging

Our solution：TPU+MAH-SEBS alternative

Solution1

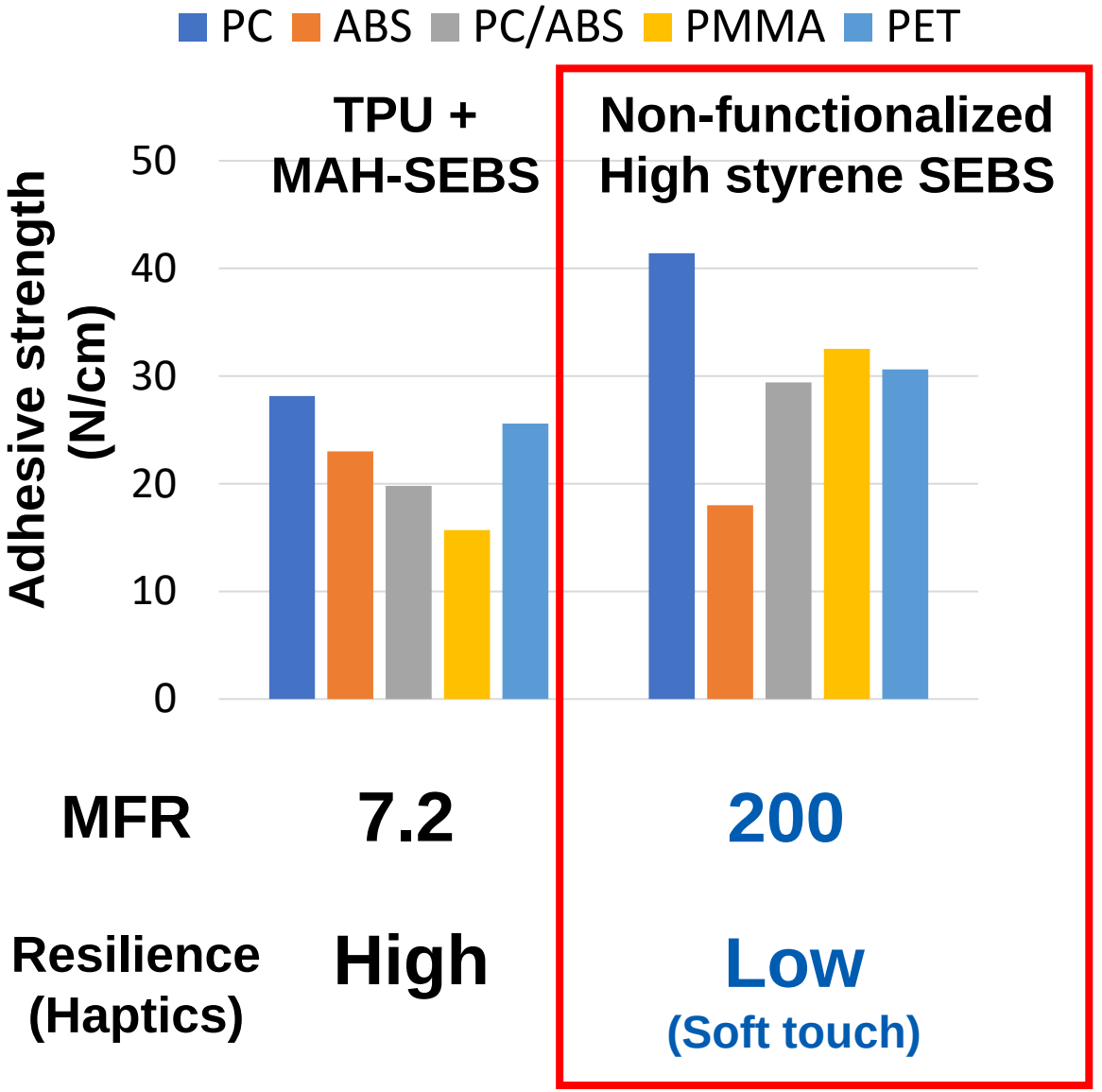
TPU + MAH-SEBS ➡ **Non-functionalized High styrene SEBS**

Benefits

- ✓ Excellent processability
- ✓ Conforming touch haptics

+

- ✓ Removal of TPU and MAH-SEBS
  - Cost reduction
  - Light weight
  - Low yellowing
  - Low odor
  - No hydrolysis
  - Regulatory friendly



Our solution：TPU+MAH-SEBS alternative

Solution2

TPU
+
MAH-SEBS

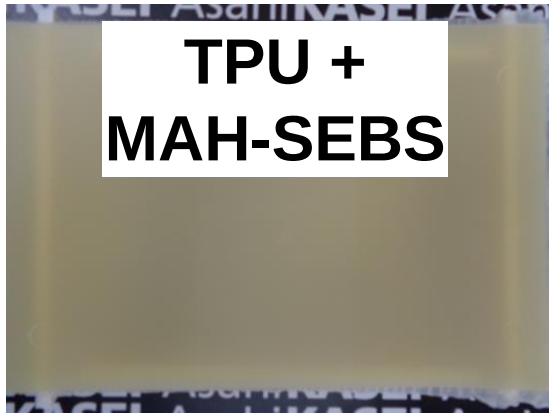
➡ **Amine-SEBS**

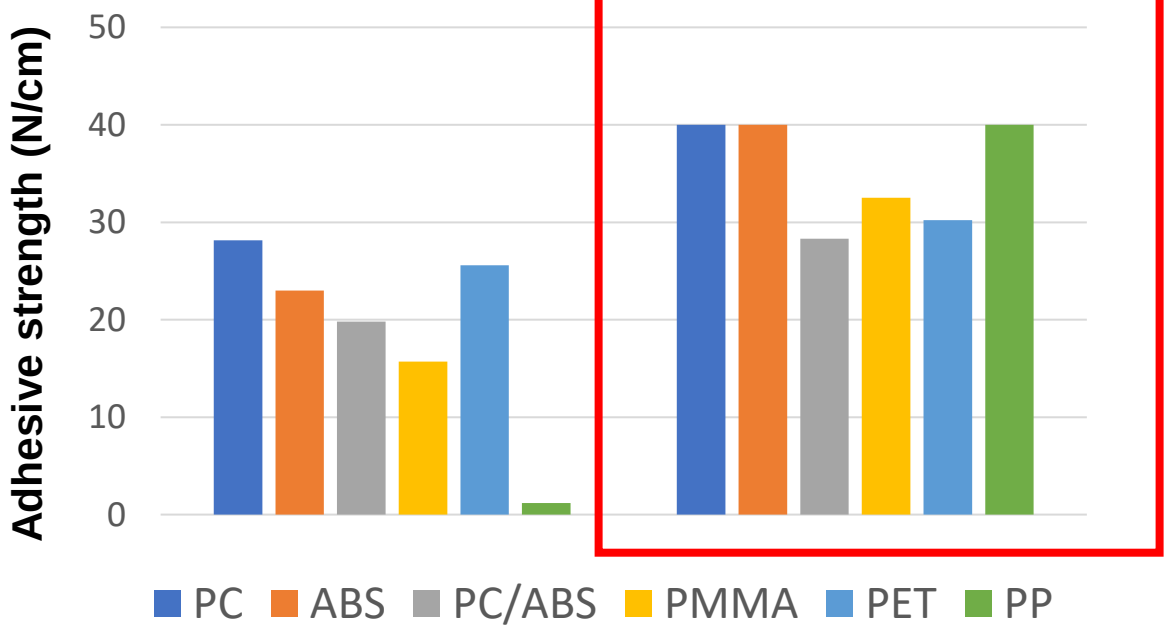
Benefits

- ✓ Excellent transparency
- ✓ Higher adhesion to polar substrates

+

- ✓ Removal of TPU and MAH-SEBS
  - Cost reduction
  - Light weight
  - Low yellowing
  - Low odor
  - No hydrolysis
  - Regulatory friendly





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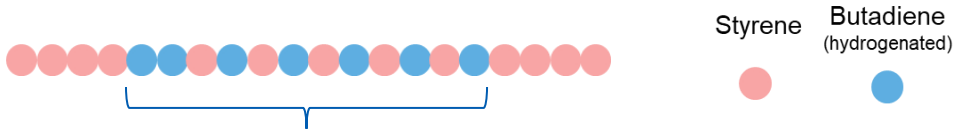
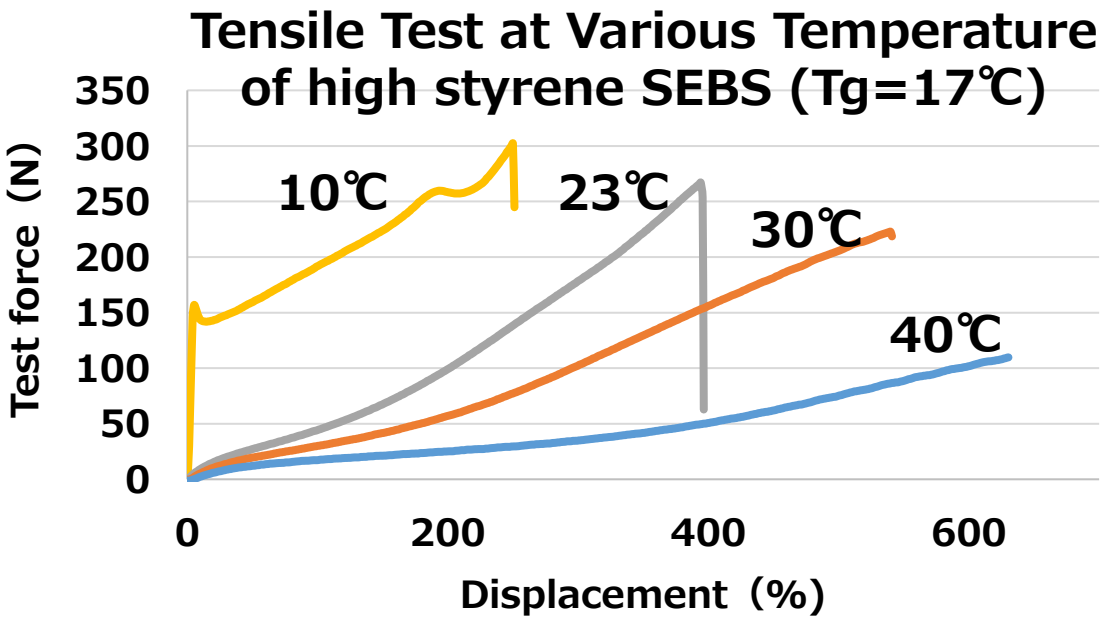
High styrene SEBS (S.O.E.)

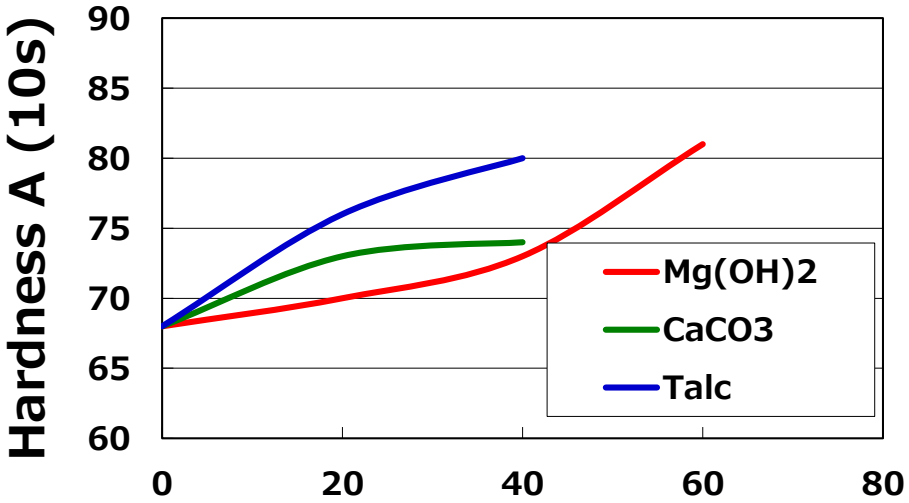


Styrene and butadiene copolymer

■ Features

- ✓ Grass transition state at room temperature
  →Softens and conforms gently with body heat.
- ✓ High SP value (High polarity)
  →Good compatibility with fillers and polar resin.





Inorganic filler content
in high styrene SEBS (%)

SEBS	100	70	50	40
$Mg(OH)_2$	0	30	50	60

High styrene SEBS S1614 for overmolding

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■ Features

- ✓ High styrene content
- ✓ Extremely high-flow
- ✓ Tanδ peak at room temperature

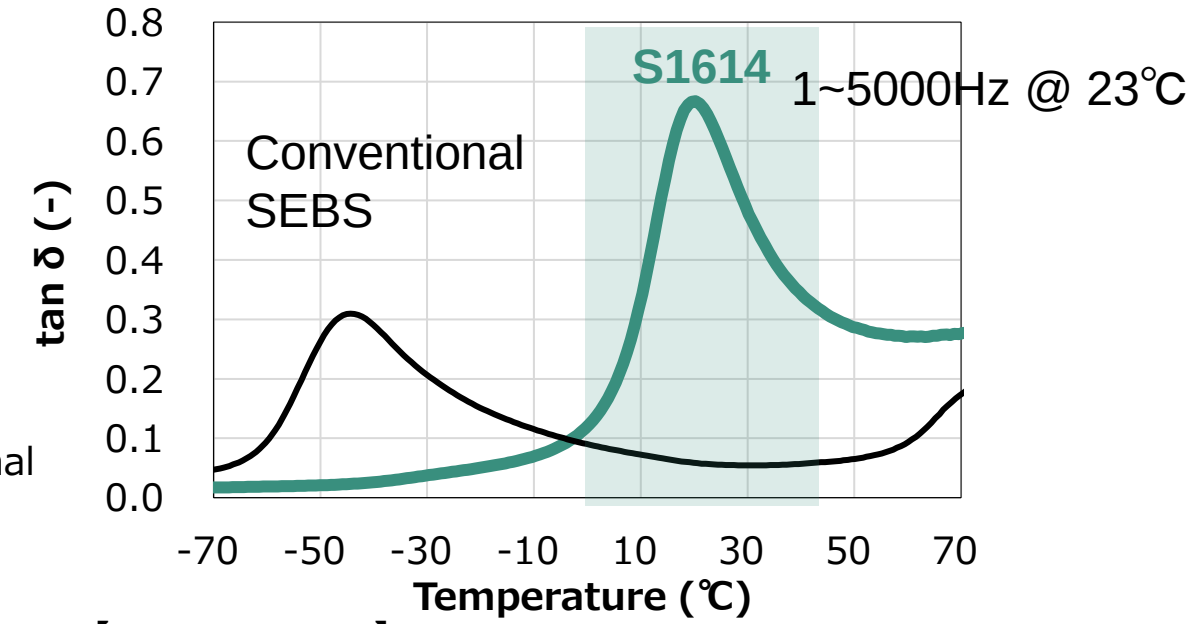
	S1614
Styrene content [wt%]	64
MFR[230℃,2.16kg, g/10min]	100
Hardness 0sec.	92A
Hardness 10sec.	85A
Tensile strength [MPa]	29
Elongation[%]	470
Tg peak [℃]	20
Resilience Dunlop[%]	10

Conventional SEBS 68%

Lower resilience than conventional SEBS

■ Benefits for overmolding

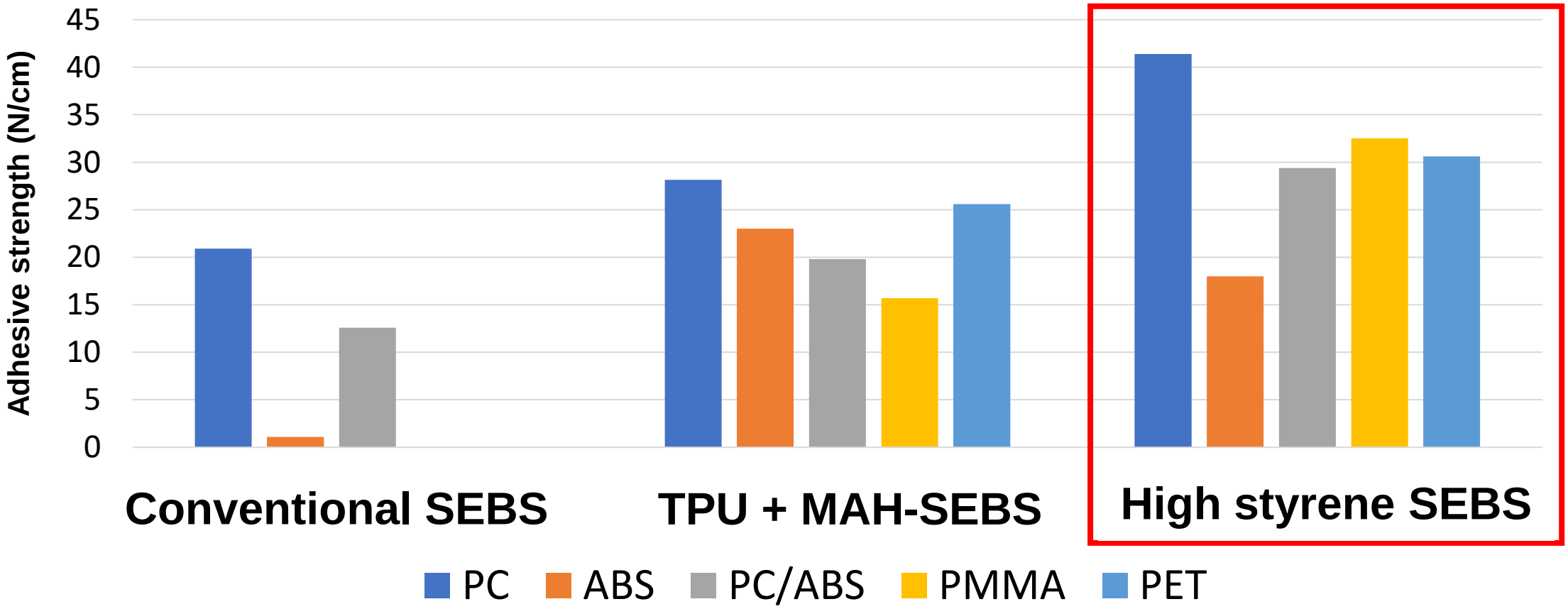
- ✓ Excellent adhesive to polar resin
- ✓ Processability
- ✓ Vibration damping at low frequencies
- ✓ Conforming touch (Low resilience)



【Test condition】
Frequency：1Hz, Heating rate：3℃/min

Adhesion strength to polar substrate

Our SEBS performs higher adhesion strength than conventional SEBS and TPU.



*Adhesion properties for conventional SEBS to PMMA and PET are not evaluated.

【Overmolding condition】
Method: Insert molding, Nozzle temperature: 240℃, Mold temperature : 40℃

【Test condition】
Peel method : 90° peel , Test speed ; 300 mm/min

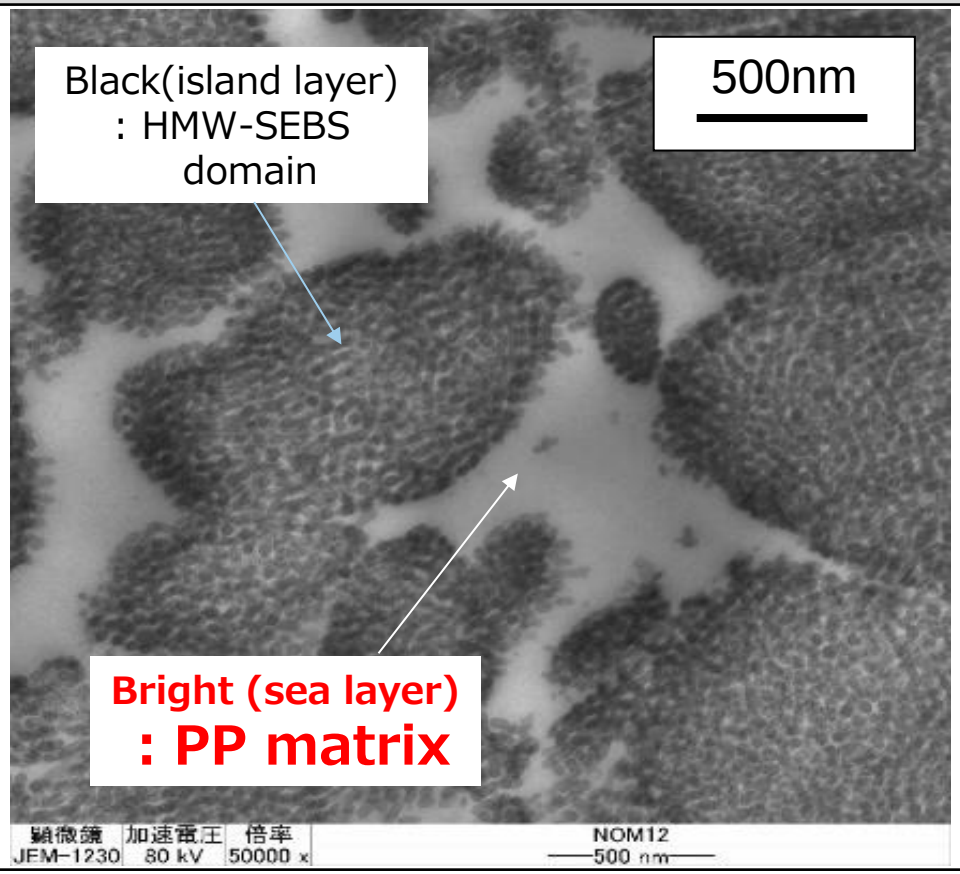
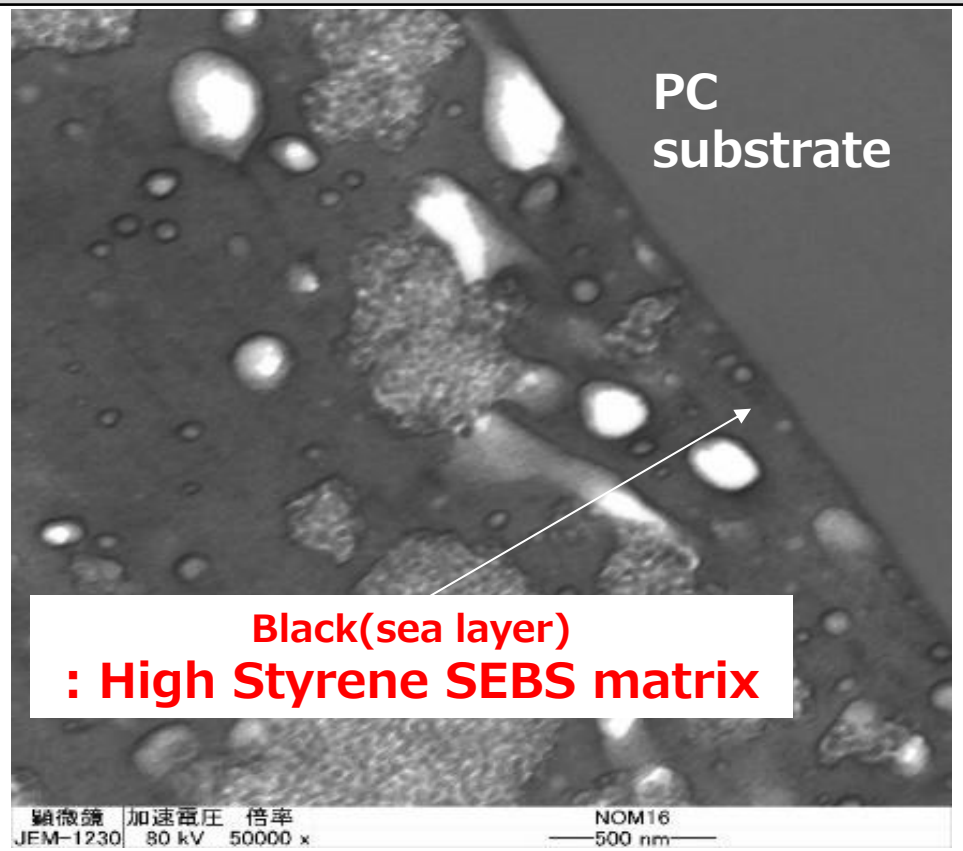
Compounds used for overmolding

			Conventional SEBS	TPU + MAH-SEBS	High styrene SEBS
Conventional SEBS		wt%	**40**		
TPU + MAH functionalized SEBS		wt%		**56**	
High styrene SEBS S1614		wt%			**40**
HMW SEBS + OIL + PP		wt%	60	44	60
Total material cost		index	–	1.00	**0.76**
Specific gravity		g/cm3	–	0.97	**0.92**
MFR (230℃, 2.16kg)		g/10 min	6.0	7.2	**200**
Hardness A	**0s**	-	62	65	**61**
	10s	-	57	61	**54**
Tensile Strength		MPa	20	5.7	8.1
Elongation		%	770	610	570
Resilience Dunlop		%	57	57	**37**

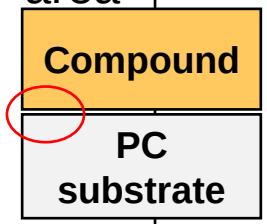
【Tensile test condition】Sample : 2mm sheet, Test speed : 500mm/min

Morphology (TEM images)

It is assumed that high styrene SEBS in matrix performs high affinity with polar substrates, resulting in excellent adhesive properties.

HMW-SEBS/OIL/PP (without high styrene SEBS)	HMW-SEBS/OIL/PP + High styrene SEBS (40%)
	

Observed area



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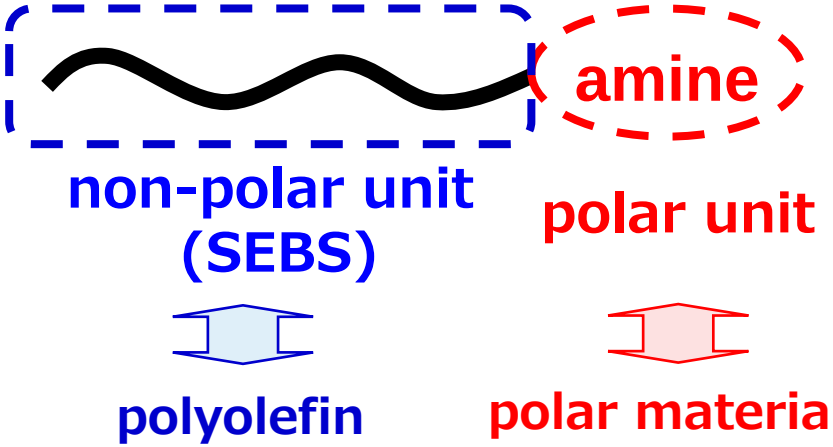
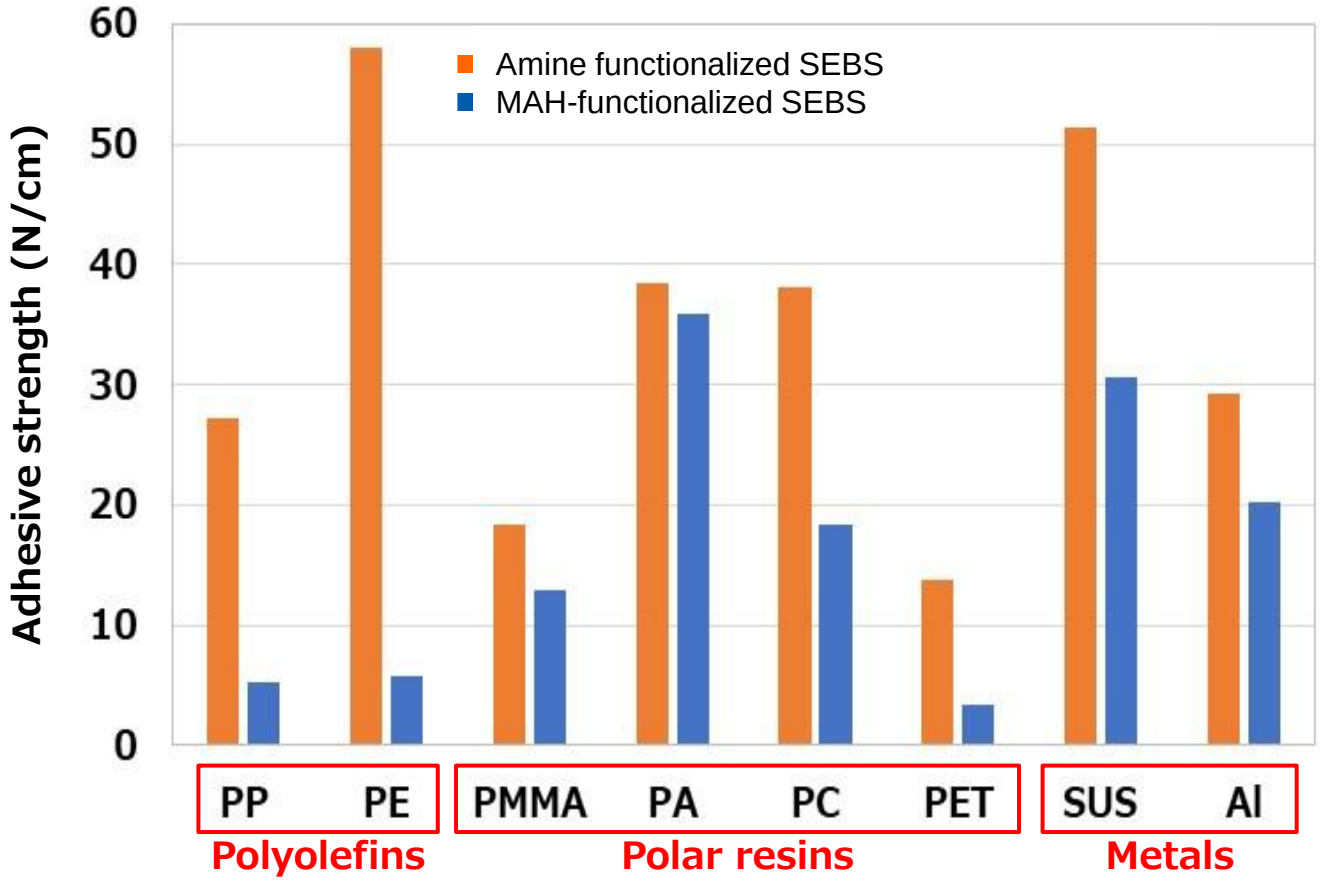
Amine functionalized SEBS

Structure of Amine-functionalized SEBS



- ✓ **Compatibilizer for polar materials and polyolefin.**
- ✓ **Different materials adhesion between high and low polarities.**

Neat polymer adhesion to substrate by thermocompression bonding



Test conditions

Each material (each 2mm) was laminated, preheated for 5 minutes, and then pressed for 5 minutes to create a laminate. After that, the elastomer layer was peeled off at 90°.
(Preheating & pressure temperature: PP,PE,PMMA; 120℃, PA,PC,PET; 180℃, SUS,Al; 200℃. Pressurizing pressure: 1kgf/cm^2)

Adhesive Strength

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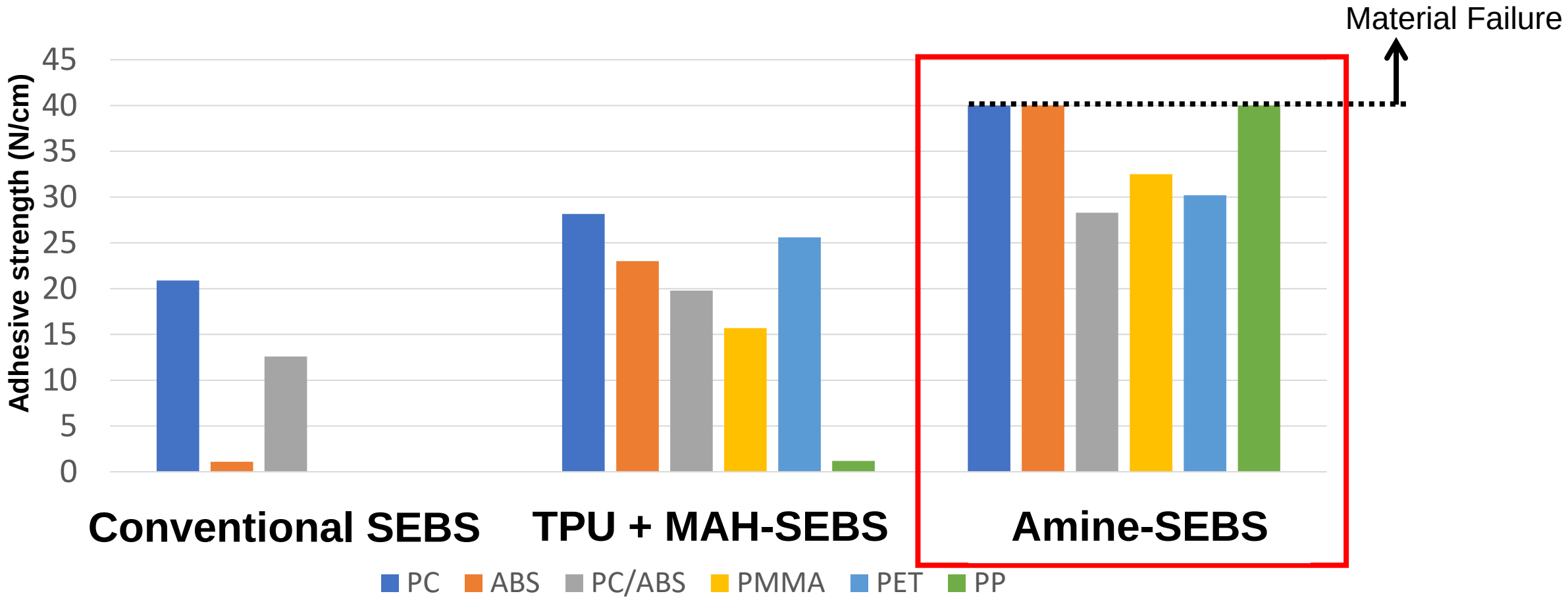
✓Excellent adhesive strength for non-polar and polar substrates



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Method: Insert molding, Nozzle temperature: 240℃, Mold temperature : 40℃

【Test condition】
Peel method : 90° peel , Test speed ; 300 mm/min

Compounds used for overmolding

			Conventional SEBS	TPU + MAH-SEBS	Amine-SEBS
Non functionalized HMW* SEBS		wt%	**20**	**26**	
Non functionalized LMW SEBS**		wt%	**40**		
TPU + MAH functionalized SEBS		wt%		**56**	
Amine-HMW SEBS AT16		wt%			**25**
Amine-LMW SEBS N528		wt%			**25**
OIL+PP		wt%	40	18	50
Total material cost		index	–	1.00	**0.76**
Specific gravity		g/cm3	–	0.97	**0.91**
MFR (230℃, 2.16kg)		g/10 min	6.0	7.2	**110**
Hardness A	**0s**	-	62	65	**62**
	10s	-	57	61	**57**
Tensile Strength		MPa	20	5.7	5.7
Elongation		%	770	610	700

* HMW means “High Molecular weight”.
** LMW means “Low Molecular weight”.

Appearance of compound plaque

Combination of Amine-functionalized SEBS leads to highly transparent compound without flow-mark.

TPU ether type

HAZE : **86**

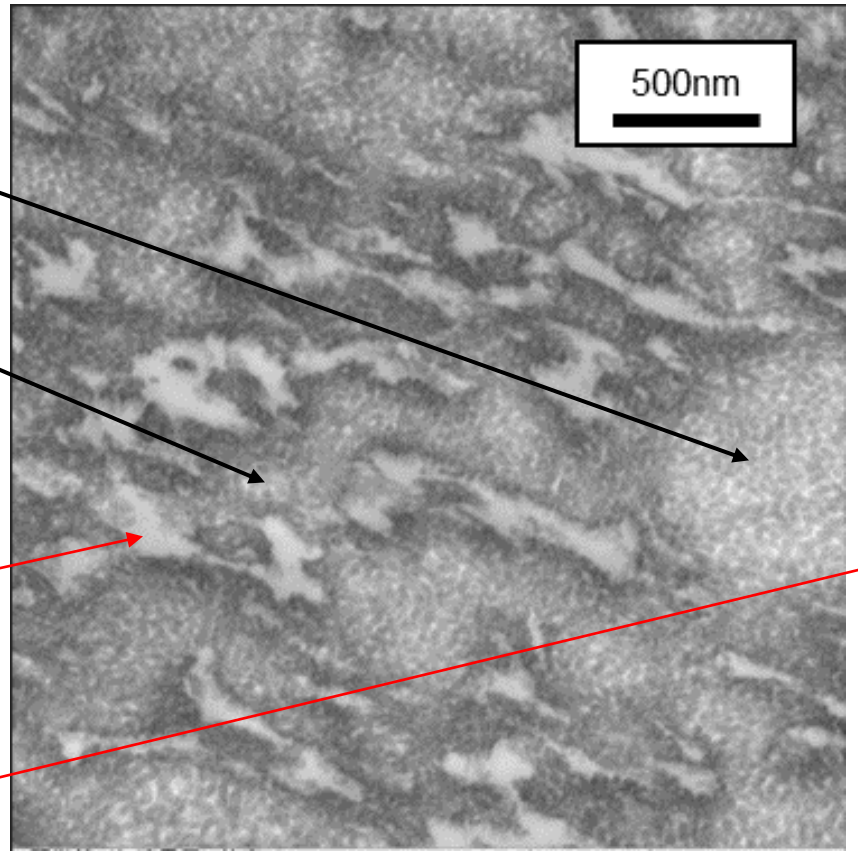
Amine-SEBS

HAZE : **22**

Morphology (TEM images)

Amine-functionalized SEBS compounds have finely dispersed PP, leading to excellent adhesion strength and transparency.

Conventional SEBS (Non-functionalized SEBS)



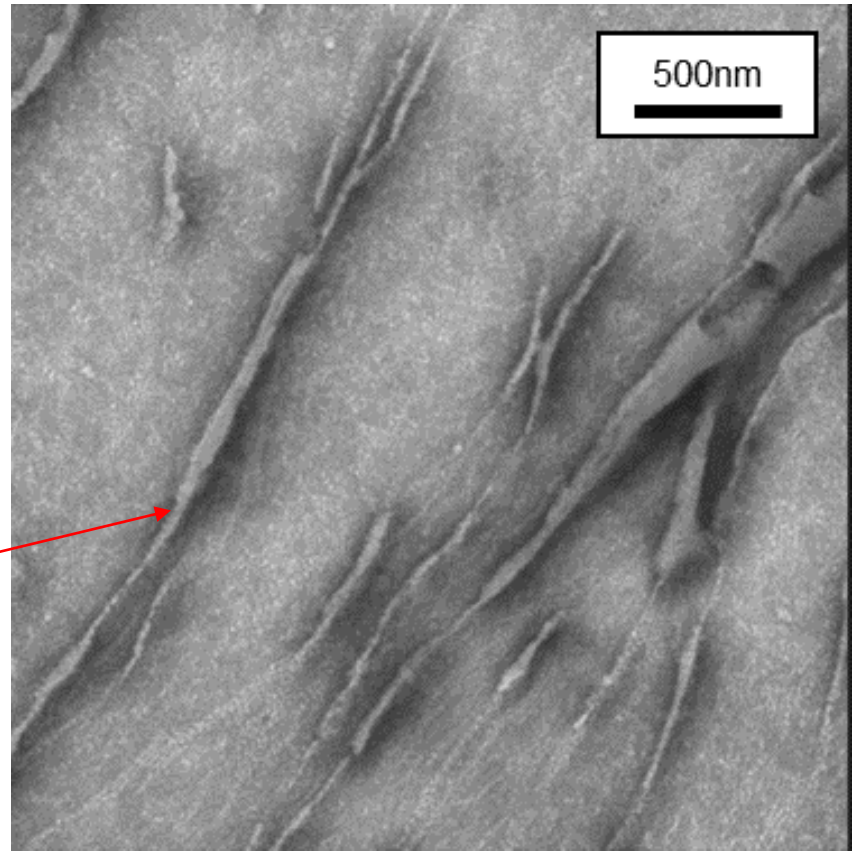
island layer
: HMW-SEBS domain

Black(sea layer)
: LMW-SEBS matrix

Bright (island layer)
: PP domain

⇒PP domains are highly dispersed.

Amine-SEBS



Summary

We have two solutions for achieving high adhesion strength to polar resins without using TPU and MAH-SEBS. This leads to cost savings, improved chemical stability, and reduced residual maleic acid impurities.

Solution1.
High styrene SEBS performs excellent processability and conforming touch haptics.

Solution2.
Amine functionalized SEBS performs excellent transparency and extremely high adhesive strength.

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Creating for Tomorrow

THE COMMITMENT OF THE ASAHI KASEI GROUP:

To do all that we can in every era to help the people of the world
make the most of life and attain fulfillment in living.
Since our founding, we have always been deeply committed
to contributing to the development of society,
boldly anticipating the emergence of new needs.
This is what we mean by “Creating for Tomorrow.”