



New adhesion possibilities with flexible grafted polyolefin



Presented by:
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Market Development Manager

Outline

- Introduction
- Grafting polyolefins
- Challenges addressed with flexible grafted polyolefins
- Bonding possibilities & applications
- Conclusions

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Grafting technology

- Grafting = process of *adding side chains/groups* to polymer backbone

- *Reactive extrusion*

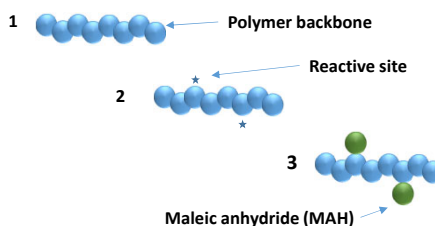
- Twin screw extruder
- Molten base material
- Reactive site created on backbone
- Bonding functional group to backbone

- *Functionalizing polymers*

- Tailoring & adding new properties
- Compatibility & adhesion
- Controlling morphology/microstructure



Adding branches to polymer



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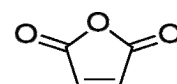
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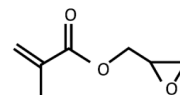
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Grafting technologies

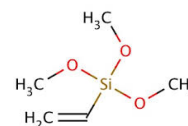
- **Different ways to graft**
 - Melt grafting with peroxide radical initiator
 - Solid state grafting with peroxide radical initiator
 - In solution (solvent) with peroxide radical initiator
 - Copolymerization
 - Radiation
- **Polymer backbone tunable**
 - Wide range of available polyolefins
 - Adverse effects on material properties
- **Bonding functional group**
 - Acid or epoxy group to enhance reactivity and polarity
 - Silane group to enhance reactivity or allow crosslink
 - Other... depending on chemistry possibilities



Maleic anhydride (MAH) group



Glycidyl methacrylate (GMA) group



Vinyl trimethoxy silane (VTMO) group

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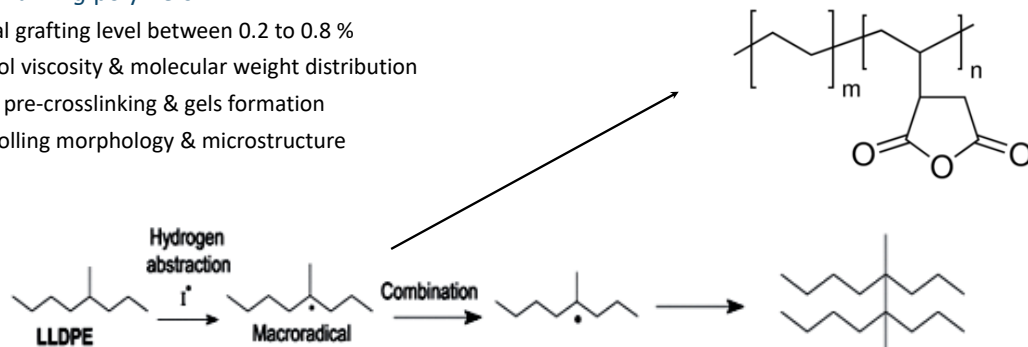
Grafting route on polyethylene

• Modification of PE backbone

- Increase of viscosity, due to branching
- Change of MFI range: divided by 2-3 with 1 % grafting
- Potential creation of gels

• Functionalizing polymers

- Typical grafting level between 0.2 to 0.8 %
- Control viscosity & molecular weight distribution
- Avoid pre-crosslinking & gels formation
- Controlling morphology & microstructure



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Grafting route on polypropylene

• Modification of PP homopolymer backbone

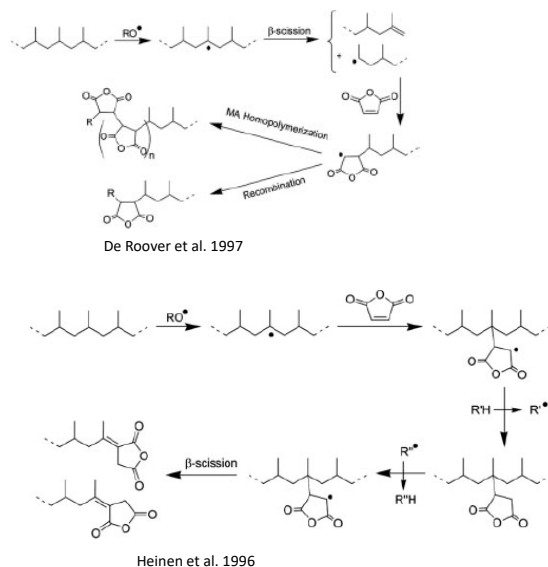
- Decrease of viscosity due to β -scission
- Change of MFI range: 2.16kg ; 230°C → 190°C
- Dispersion of molecular weight

• Modification of PP copolymer backbone

- Decrease of viscosity due to β -scission
- Ethylene blocks limit the degradation of M_w

• Functionalizing polymers

- Possible grafting level between 0.2 to 3%
- Ensure low modification of melting point
- Limit the degradation and the dispersion of M_w
- Maximizing the grafting efficiency



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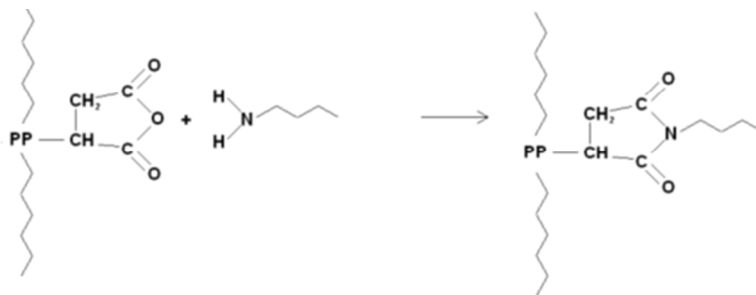
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Challenges addressed with grafted polyolefins

- Allow a polyolefin to bond on polar substrate: **polymer, fabrics, metal...**

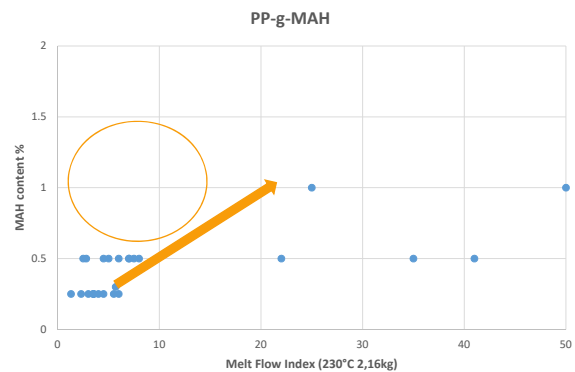
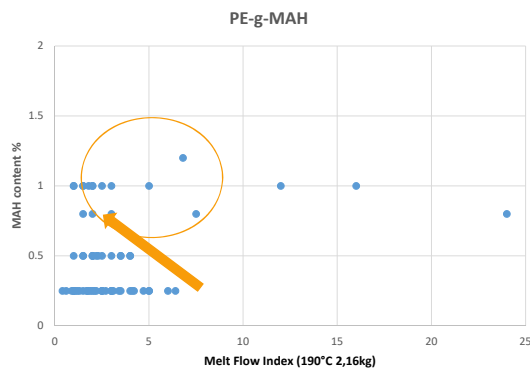


- Compatibilize polar/unpolar polymers
- Coupling polyolefins with fibers or fillers

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Adhesive resins for extrusion applications

- Existing PE-g-MAH & PP-g-MAH suffer chemistry technology limitation



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Challenges to be addressed by grafting polyolefins

- High maleic anhydride content
- Controlled MFI
- Low free-MAH, low volatiles content
- Economically sustainable process

*Need for highly efficient melt-grafting production, with appropriate backbone
Allowing to address these challenges in the most economical way*

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Appropriate backbone selection for grafting

- *Semi-crystalline copolymers*
 - Propylene-rich copolymers
 - Based on metallocene technology
 - With high flexibility
 - Compatible with other polyolefinic materials
 - Uniform inter & intramolecular composition as well as crystallinity distribution

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Combining elastomer & adhesion promoter

- *Combining excellent properties for adhesives & compounds formulation*
 - Carefully selected backbone driving enhanced flexibility & processability
 - Adjustable MFR for good process control
 - Tailored MAH content enabling controlled formula cost-efficiency
 - Great fit in wide range of applications, including as tie-layer & adhesion promoter

Additional features of new flexible grafted polyolefin

- Improved mechanical properties
- Higher adhesion performance

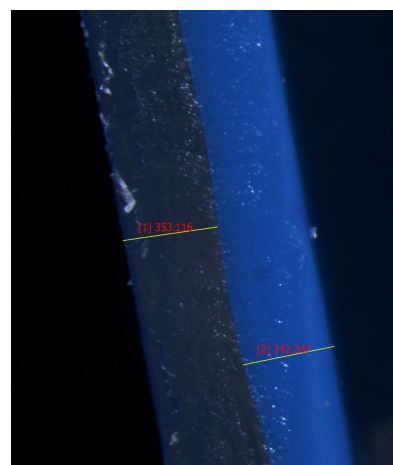
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Bonding possibilities with flexible grafted polyolefin

- *MAH group function to create chemical bonding to flexible polar substrates:*
 - Aluminium foil
 - Polyester yarns & non-woven
 - TPU, EVOH & other technical polymers
- *High performance adhesion promoter with:*
 - High MAH content for improved bonding strength
 - High material flexibility
 - MFR adapted to several extrusion processes



Acti-Tech™ compatibilizers/
TPU coextruded sheet

Applications (1)

- Tie-layer for TPU/PE foam
 - Protection of PE foam by extrusion coating



- Adhesion promoter on cotton fabrics:
 - Production of tablecloth by calendering
 - PVC substitution (flexibility & transparency)



Acti-Tech™ compatibilizers

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Applications (2)

- Multilayer films & sheets with PA, PET, EVOH or TPU
- Metal coating
- Flexible reinforced hoses
- TPU belt calendaring without solvent
- Recycling:
 - Recycled PET sheets
 - Multilayer barrier films

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A functional material for tailored applications

Key features & benefits:

- Adjustable viscosity with MFR:
 - Improved process control
 - Larger use of extrusion processes
- High MAH content:
 - High functionalization for improved bonding
 - Particularly efficient adhesion promoter on larger range of polyolefin
 - Less loading level required as compatibilizer
- Highly flexible material
 - Wide range of flexural modulus
 - Softer compared to regular PE- or PP-grafted polymers
 - Highly efficient impact modifier for PP alloys with engineering plastics, i.e. recycling



*Thank You
for sticking with me*

Presented by:

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