



# New developments in TPEs for dynamic applications

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Dynamic characterization and simulation of elastomers

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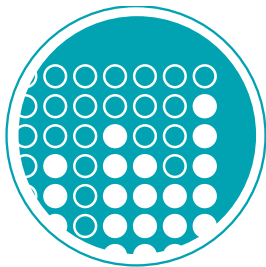




# LEARTIKER POLYMER

**POLYMER ENGINEERING RESEARCH AND SERVICES** focused on two main sectors:

HEALTH



SUSTAINABLE  
TRANSPORT



**50** Highly qualify  
**professionals**

(PhD., MSc., Ing., BSc.)



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**Headquarters**

LOCATED IN MARKINA-XEMEIN  
(50KM FAR FROM BILBAO AIRPORT)



# SUSTAINABLE TRANSPORT

## SPECIALIZATION AREA

### SUSTAINABLE TRANSPORT

All-around development of  
**RELIABLE, LIGHTWEIGHT** and  
**SILENT** polymeric structures

## SCOPE OF APPLICATION

THERMOPLASTIC COMPOSITES

THERMOSET COMPOSITES

ELASTOMERS

## KNOWLEDGE FIELDS

1 MATERIAL

2 PROCESS

3 CHARACTERIZATION

4 FE SIMULATION/  
DIGITALIZATION

**INTEGRAL SERVICE** that covers the entire value chain:

### MATERIAL

- + Short fiber
- + Long fiber
- + Thermoplastic prepregs
- + SMC
- + TPE
- + Compounding

### TESTING

- + Static
- + Impact
- + Dynamic (NVH)
- + Fatigue

### SIMULATION

- + Moldflow
- + Digimat
- + Ansys/Abaqus

### PROCESSING

- + Mold design
- + Prototype injection
- + Preserial production

### CORRELATION

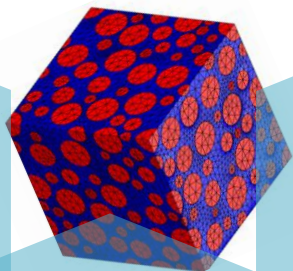
- + Prototype testing and simulation
- + Close loop design and material optimization



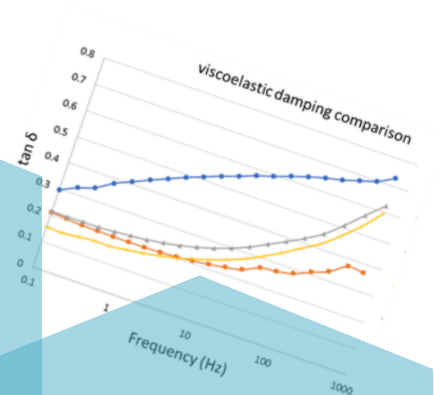
Advancing the use of TPEs in demanding dynamic applications

## RESEARCH ACTIVITIES

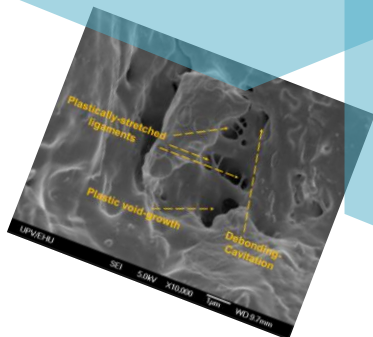
Research on design and development of TPEs for structural vibration damping applications



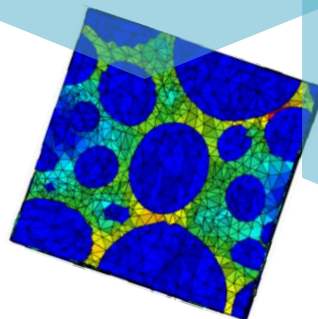
Digitalization of the dynamic behavior of TPEs by means of advanced material models



Research and implementation of integrative simulation and characterization methodologies to define the process-structure-properties relationship in TPEs



Development of specific dynamic testing methods for TPEs (DMA, ...)





# SOLVING SUSTAINABLE TRANSPORT CHALLENGES WITH TPE MATERIALS

New technological challenges in electric vehicles (EVs):



Lightweighting



Noise and vibration performance



Increasing demand of  
lightweight materials with vibration  
damping properties

To overcome these new demands  
traditional design and material  
choices need to be reconsidered

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TPE materials  
represent an  
interesting solution  
due to:

- ✓ Low density
- ✓ Recyclability
- ✓ Easy processing
- ✓ Design flexibility
- ✓ Tailored and wide range of final properties



Huge number of  
opportunities for TPEs  
with vibration damping  
properties

Great deal of room for research  
and developments

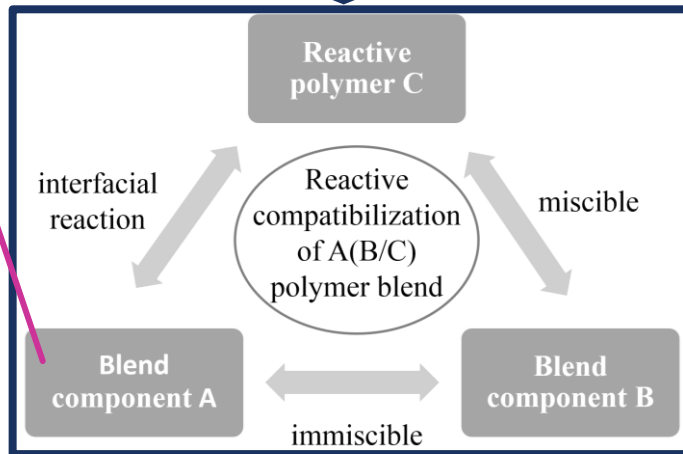
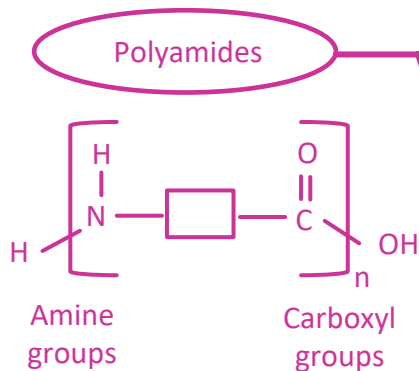


# DESIGN AND DEVELOPMENT OF TPEs WITH UPGRADED VIBRATION DAMPING PROPERTIES

Cost-effective approach to develop new TPEs

Compatibilization of immiscible rubber-thermoplastic blends  
Key strategy to develop new TPEs with superior properties

Reactive  
blending



Co-rotating twin screw extruder  
Most widely used method to prepare TPE blends by reactive blending



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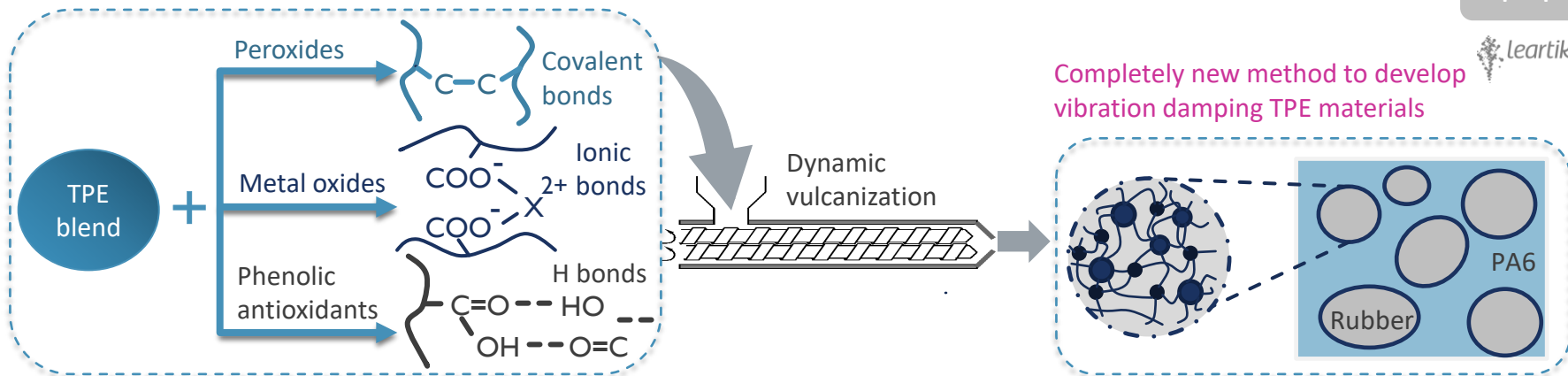


# DESIGN AND DEVELOPMENT OF TPEs WITH UPGRADED VIBRATION DAMPING PROPERTIES

Exploring novel strategies to improve the vibration damping properties of TPE blends

## Design concept

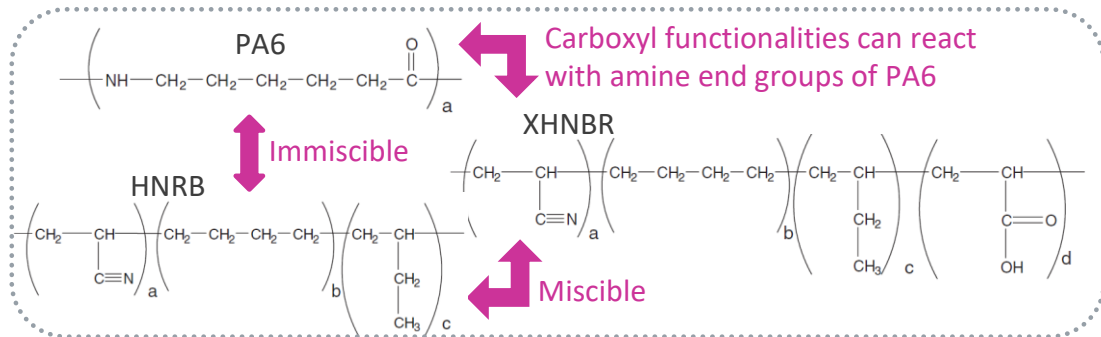
The addition of metal oxides and hindered phenolic antioxidants can improve the vibration damping properties of carboxylic rubbers



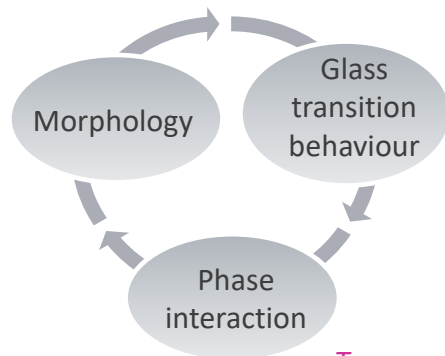
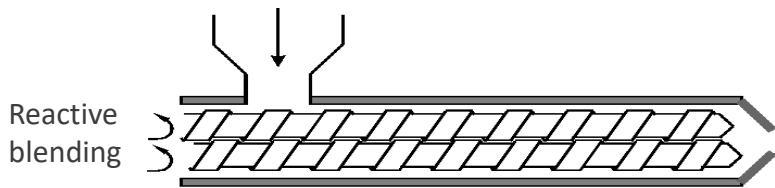


# DESIGN AND DEVELOPMENT OF TPEs WITH UPGRADED VIBRATION DAMPING PROPERTIES

## Development of new TPVs



+ peroxides, metal oxides, phenolic antioxidants



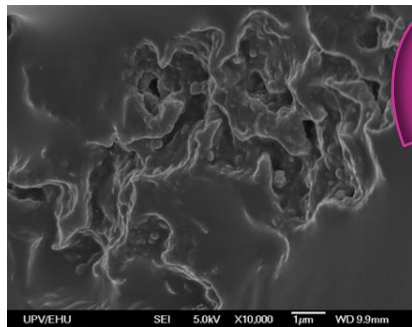
*T<sub>g</sub> governs the service temperature range and viscoelastic damping performance*





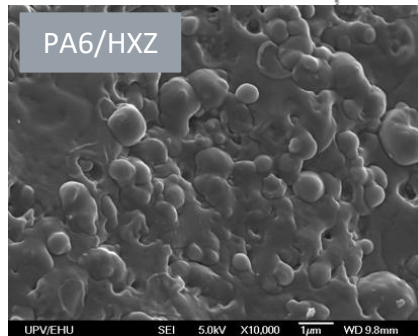
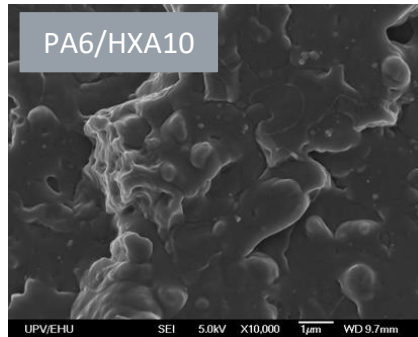
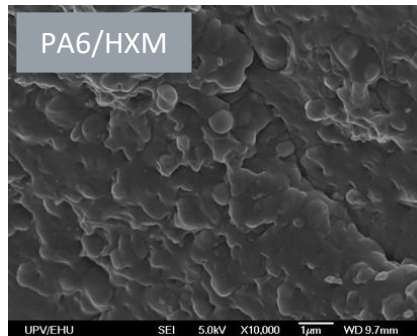
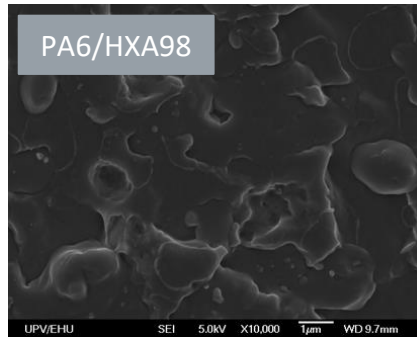
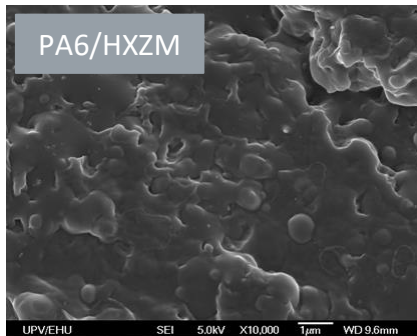
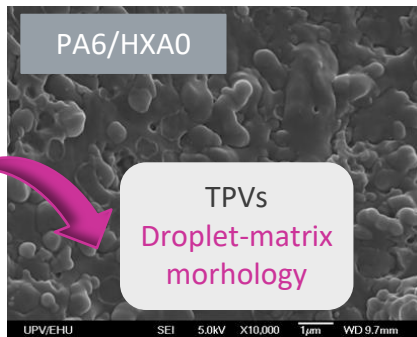
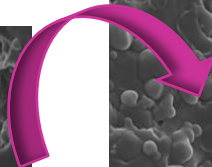
# DESIGN AND DEVELOPMENT OF TPEs WITH UPGRADED VIBRATION DAMPING PROPERTIES

## Morphological investigation (SEM)



TPE blend  
Co-continuous morphology

Dynamic  
vulcanization



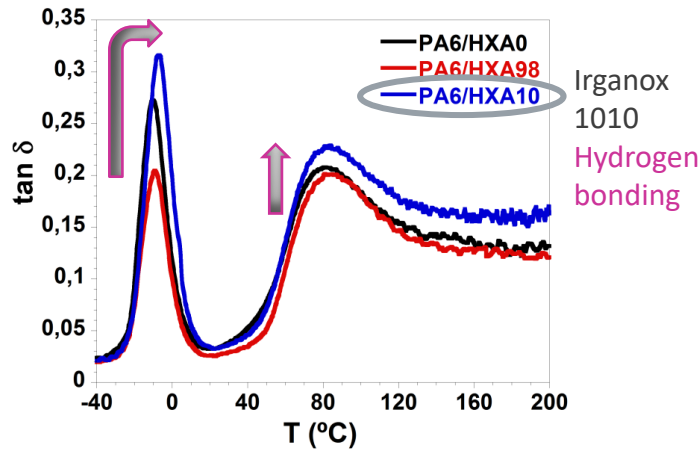


# DESIGN AND DEVELOPMENT OF TPEs WITH UPGRADED VIBRATION DAMPING PROPERTIES

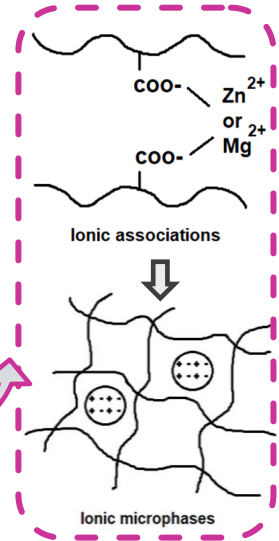
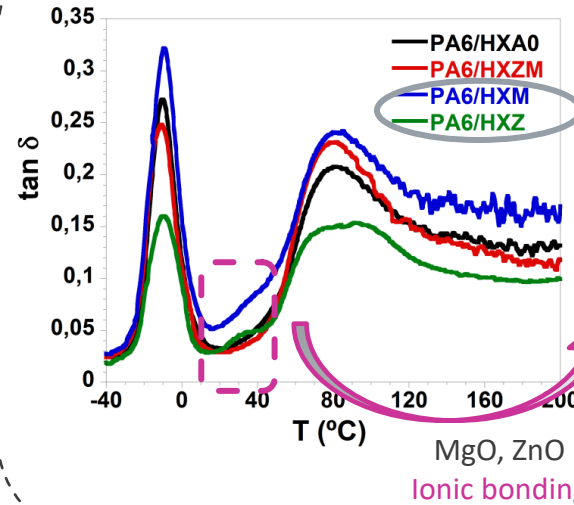
## Dynamic mechanical analysis (DMA)

Effect of different crosslink systems on damping properties

Hindered phenolic antioxidants



Metallic oxides

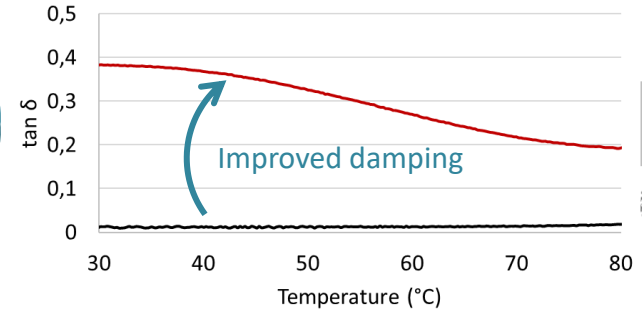
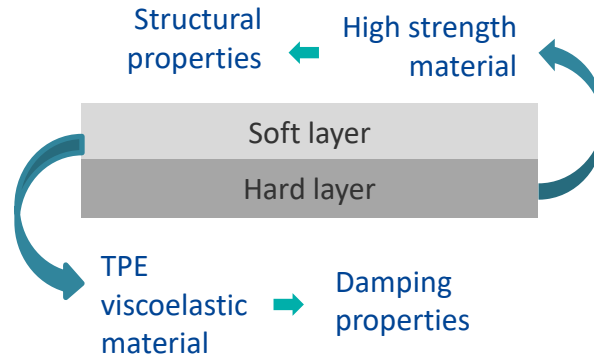
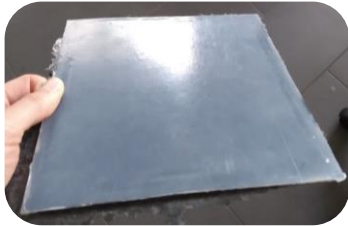




# DESIGN AND DEVELOPMENT OF TPEs WITH UPGRADED VIBRATION DAMPING PROPERTIES

Passive solution to suppress the vibrations of structural components

Design of hybrid structures with high strength and improved damping properties



Advantages with respect to metal/rubber hybrid components:

- ✓ Lightweighting
- ✓ Design flexibility



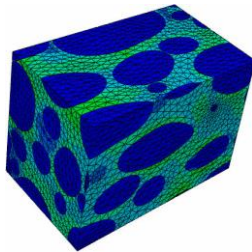
## ONGOING RESEARCH ACTIVITIES

- Definition of a TPE based demo part:
  - Customer focus demo part
  - Testing focus demo part
- Explore full potentialities of TPEs for EV structural vibration/noise challenges



Testing and simulation of dynamic properties

- Rubber  $\neq$  TPE



- Two phases
- Anisotropy
- Inelastic stress-strain behaviour

Integrative  
simulation

- Characterization methods
- New material models
- Process-performance digitalization



# Thank you

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