

## Mechanical properties of polymer / clay nanocomposites

***Citation for published version (APA):***

Sarkissov, A. U., Fischer, H. R., & Meijer, H. E. H. (2001). *Mechanical properties of polymer / clay nanocomposites*. Poster session presented at Mate Poster Award 2001 : 6th Annual Poster Contest.

***Document status and date:***

Published: 01/01/2001

***Document Version:***

Publisher's PDF, also known as Version of Record (includes final page, issue and volume numbers)

***Please check the document version of this publication:***

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

[Link to publication](#)

***General rights***

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the "Taverne" license above, please follow below link for the End User Agreement:

[www.tue.nl/taverne](http://www.tue.nl/taverne)

***Take down policy***

If you believe that this document breaches copyright please contact us at:

[openaccess@tue.nl](mailto:openaccess@tue.nl)

providing details and we will investigate your claim.

# Mechanical Properties of Polymer / Clay Nanocomposites

A. Sarkissov, H. R. Fischer\*, H. E. H. Meijer

Eindhoven University of technology, Department of Mechanical Engineering

\* TNO Institute of Applied Physics

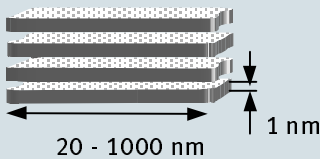
## Introduction

Hybrid inorganic/organic nanocomposites based on polymers reinforced with silicate minerals (clay) can exhibit marked improvement in properties like stiffness, barrier, thermal stability, flame retardance at low filler content of approximately 5wt%. The goal of this project is to investigate the micro mechanical behaviour of these materials and link it with their macroscopic properties.

## Materials and Methods

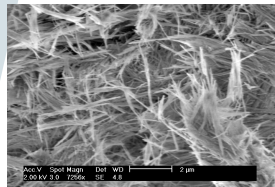
Clays are naturally occurring highly crystalline hydrophilic minerals. Two types of clays were used as a reinforcing elements for the PE and PP matrix.

### Layered silicates



- High aspect ratio platelets
- Surface area ~ 800m<sup>2</sup>/gr.
- Negatively charged layers balanced by alkali cations

### Fibrilous clay minerals



- High aspect ratio  
L=400-600 nm,  
D=20-30 nm
- Hollow structure

## Nanocomposite preparation

Clays are rendered organophilic through ion exchange reactions with organic cations and subsequently dispersed into polymer matrix via extrusion melt mixing. In the case clay platelets three types of structures are obtainable depending on the **thermodynamic interactions** between the matrix and clay layers:



Phase separation



Intercalation



Exfoliation

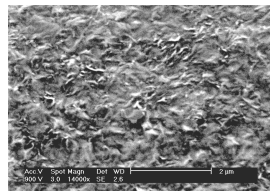
⇒ Using surface modifying agents for the clay to promote more favourable clay-polymer interactions.

For the PP matrix clay was modified using PEO-EBE block copolymer, for the PE based nanocomposite PE-MAS was used as a modifier.

## Results

### Layered clay minerals

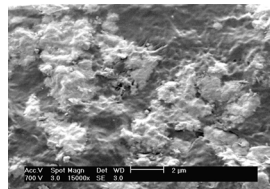
PE / Somasif 5%



Clay platelets are homogeneously dispersed

Material	E-modulus, MPa
Pure PE	420
PE/clay 5%	710

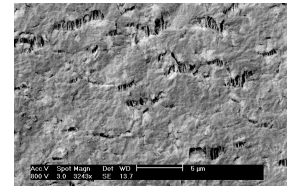
PP / Montmorillonie 5%



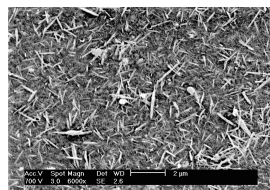
Distribution of clay platelets and tactoids

Material	Impact Energy, kJ/m <sup>2</sup>
Pure PP	4.9
PP/clay 5%	7.0

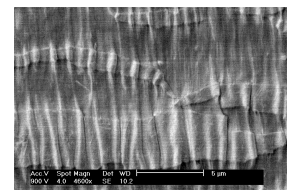
In-situ tensile testing under ESEM shows formation of crazes around clay tactoids



### Fibrilous clay minerals



Homogeneous dispersion of fibrilous clay particles



Fibrils formation during tensile deformation

## Future work

- Further investigation of the morphology, crystallisation and structure development of polymer / clay nanocomposites
- Investigation of the deformation behaviour of polymer/clay nanocomposites by means of in-situ SAXS, WAXS, ESEM, AFM