

## TECHNOLOGY OFFER

### CRYSTALLINE POLYIMIDE MICROSHEETS IMPROVING OUT-OF-PLANE THERMAL CONDUCTIVITY OF POLYIMIDE FILMS



Polyimide (PI) films are used as high-performance insulating materials. The constantly growing demand for thermal management of electronic devices makes an improvement of their heat dissipation behavior necessary. In usual PI films in-plane thermal conductivity is much higher than out-of-plane thermal conductivity. For improving the heat dissipation behavior, out-of-plane thermal conductivities have to be improved.

TU Wien has developed an environmentally friendly method to synthesize highly crystalline, flat polyimide microsheets on a large scale. When preparing composite films, they can be efficiently aligned in parallel to each other and to the matrix film. Since the polymer chains in these microsheets are arranged perpendicularly to the microsheet surface (i.e. in the out-of-plane direction), they allow to prepare PI-PI composite films with improved out-of-plane thermal conductivities.

#### BACKGROUND

TU Wien has developed an environmental friendly method to synthesize polyimides (PIs). Hydrothermal polymerization (HTP) uses solely high-temperature water and the monomers. No toxic solvents or catalysts are required. Polyimides generated with HTP are outstandingly crystalline and therefore of high thermal, mechanical and chemical stability.

#### TECHNOLOGY

For preparing flat polyimide microsheets, a monomer salt based on pyromellitic acid (PMA) and p-phenylenediamine (PDA) is prepared in a first step. Subsequently, it is transformed to poly(p-phenylene)pyromellitimide (PPPI) via HTP. By applying shear forces during HTP via stirring the desired flat PPPI microsheets with an out-of-plane orientation of polymer chains can be generated.

Typically, these microsheets have a particle size between roughly 2 and 11  $\mu\text{m}$ . When such microsheets of sufficient aspect ratio are mixed with viscous polymer solutions, they can be aligned in parallel to the resulting film by applying conventional film formation processes such as spin coating or bar coating. However, by applying high frequency ultrasonication treatment it is also possible to intentionally decrease the average particle size of the microsheets.

#### ADVANTAGES

- Flat polyimide microsheets to be used as filler material for composite films
- Improving out-of-plane thermal properties of composite films
- Improving thermal, chemical and mechanical stability of composite films
- Green preparation process, no toxic solvents or catalysts required

#### REFERENCE:

M002 /2019

#### APPLICATIONS:

Membrane technology /  
Insulating materials for electronics / Automotive / Plant engineering / Aeronautics

#### KEYWORDS:

High performance polymers  
Polyimides /  
Microsheets /  
High crystallinity /  
Polymer processing /  
Green synthesis /  
PI-PI composites

#### IPR:

Patents pending

#### OPTIONS:

R&D co-operation  
License contract

#### INVENTORS:

Miriam M. Unterlass  
Michael J. Taublander

#### CONTACT:

Tanja Sovic  
TU Wien  
Research and Transfer Support  
T: +43.1.58801.41537  
[tanja.sovic@tuwien.ac.at](mailto:tanja.sovic@tuwien.ac.at)  
[www.rt.tuwien.ac.at](http://www.rt.tuwien.ac.at)

