Micro 2C-injection moulding - investigations on interface performance

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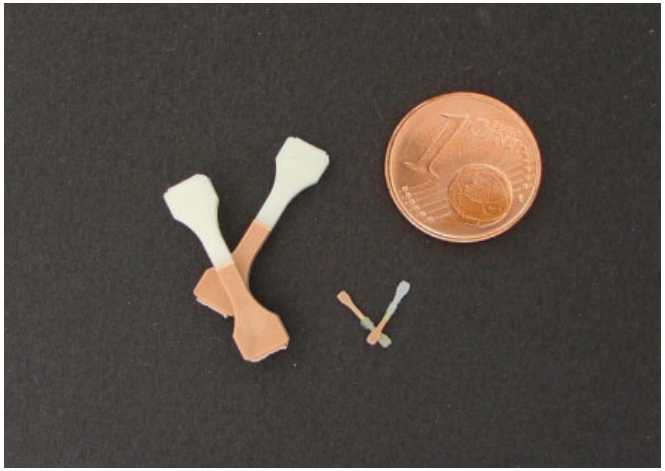
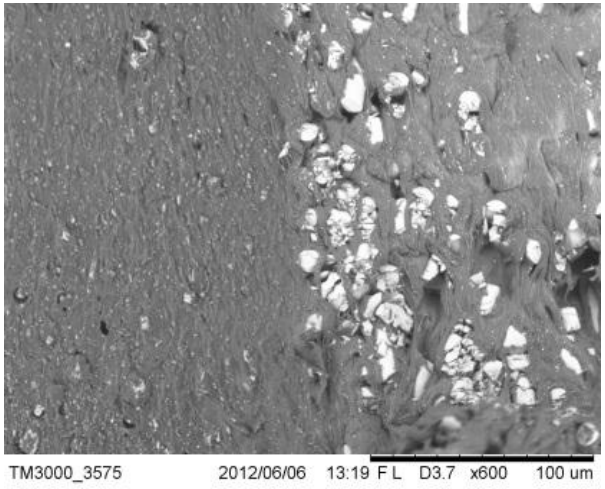




Outline of the talk

1. A new approach for 2C-µIM
2. Realisation of the new approach for 2C-µIM
3. Investigations and results of the test specimen, especially on interface performance
4. Summary & Outlook

A new approach for 2C-µIM

A new approach for 2C-µIM

- biggest advantage: the possibility to use two machine units as individual machines if no multi-component parts has to be produced
- flexibility
- higher degree of utilisation
- realisation of the individual processing for each component (tool temperature, isothermic and/or variothermic processing, back pressure and /or compression, etc.)

→ ***main question: differences between new approach for 2C-µIM and "classic" 2C-µIM***

Realisation of the new 2C-µIM

two versions of process sequence (tensile bar as test specimen) ***:***

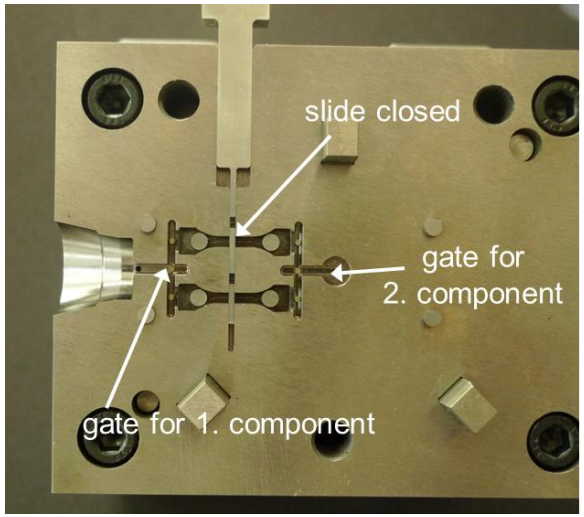
- "classical" 2C µ-IM:
  injection of the second component immediately (0.2s)
  after removing slide bar

- approximation of the new 2C µ-IM:
  1) The tempered tool closes
  2) Injection of the first component PA
  3) The slide bar opens after the chosen stand-by time (5 or 10s)
     ~ transfer time
  4) Injection of the second component TPE
  5) After the cooling time the tool opens
  6) Ejection of the tensile bar

Realisation of the new 2C-µIM

Advanced Wittmann Battenfeld Microsystem 50-2K machine with L-position of the second injection unit at KIT

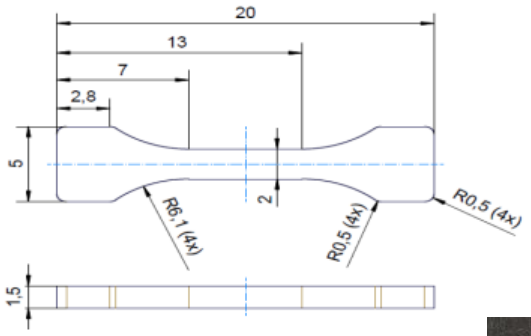
2C- tool manufactured by Technical University of Denmark (DTU):

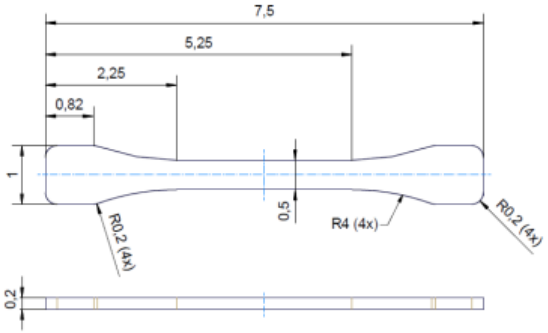


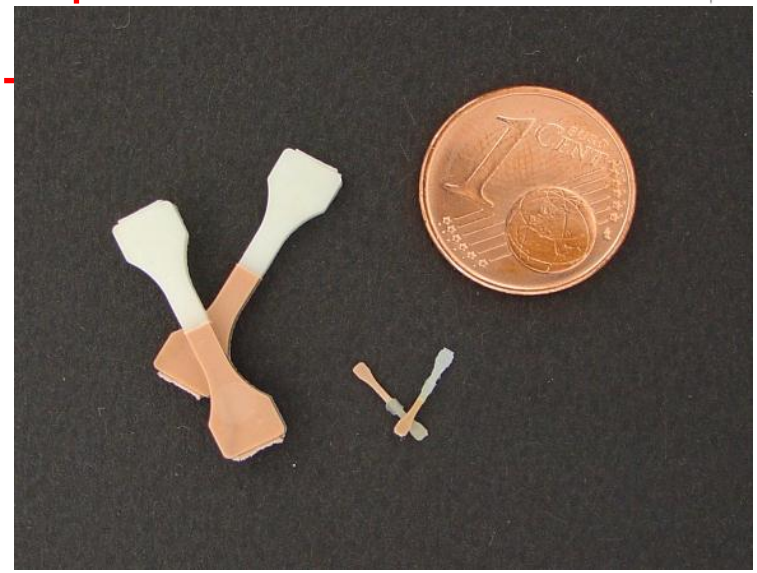
ejection side

Realisation of the new 2C-µIM

Test specimen:







Realisation of the new 2C-µIM

Materials:

Material	Trade name	Distributor
PA 6.6	Ultramid A3EG10	BASF (coloured red, supplied by Sonion)
TPE	Lifoflex UV 63.01B045	Müller Kunststoffe
	THERMOFLEX 60A3.4	Plastic Technologie Service
	THERMOFLEX 60A3.4HS	Plastic Technologie Service
	Santoprene 8291-60B500	ExxonMobil chemical

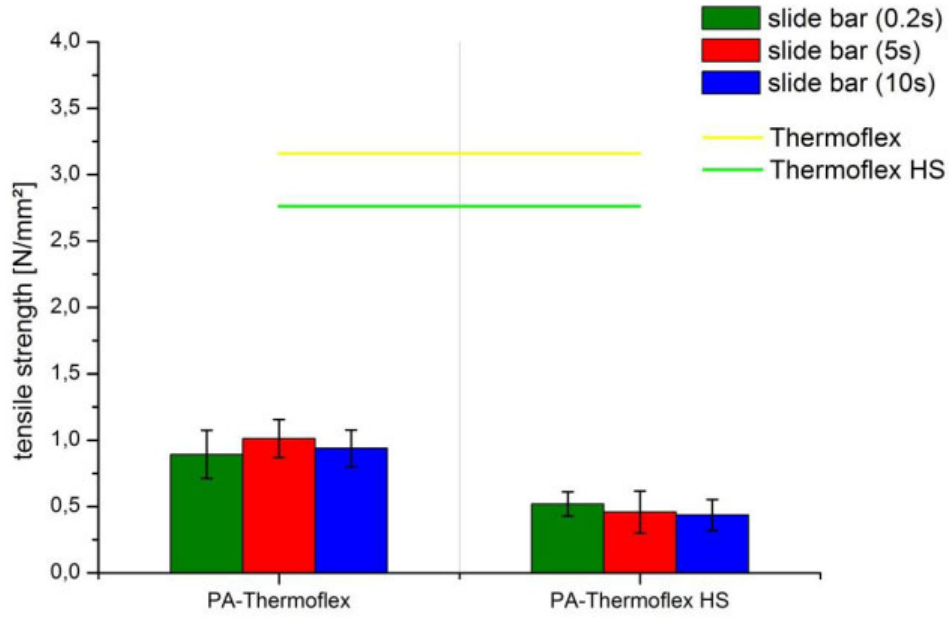
Performing:

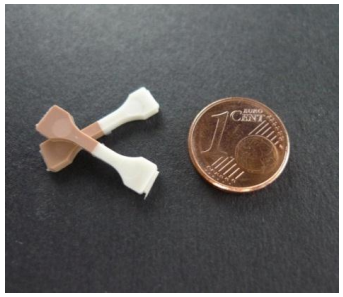
- tool temperature: 70°C (maximum for TPE's) and 80°C (minimum for PA)
- further process parameters were adjusted to the particular materials
- determination: tool temperature with enormous influence on the realisation of the bonding quality

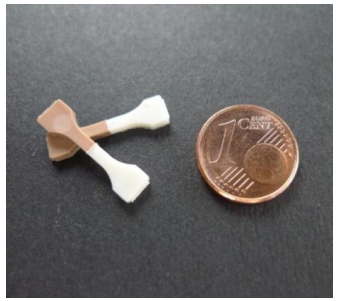
Investigations and Results

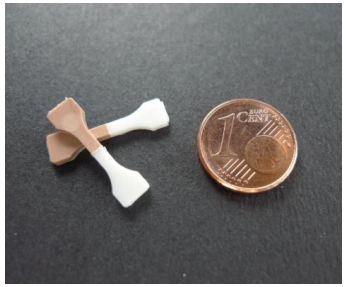
Tensile tests at Freiburg University***:***

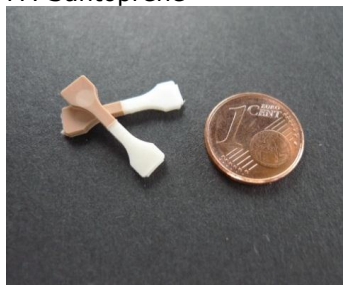
- testing set-up consists of a modified Zwick Z010 tensile testing machine
- testing of the tensile bars are in relation to DIN 53504




PA-Lifoflex


PA-Santoprene

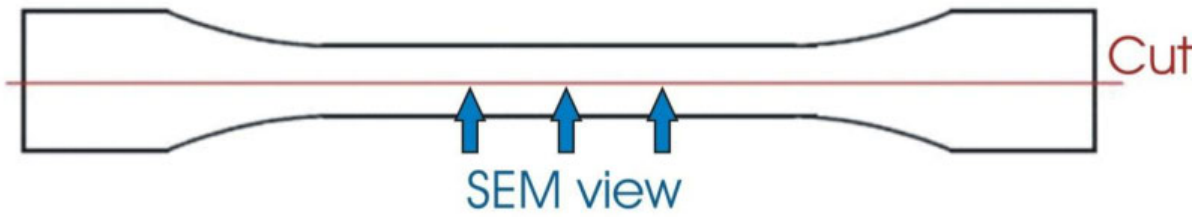

PA-Thermoflex HS


PA-Thermoflex

Investigations and Results

Cryogenic cutting and microscopic investigation at Bradford University***:***

- investigation of the interface between PA and TPE of two versions of process sequence
- preparation: clamped, immersed in a liquid nitrogen bath (40 sec) and sectioned in two half by a very sharp scalpel blade

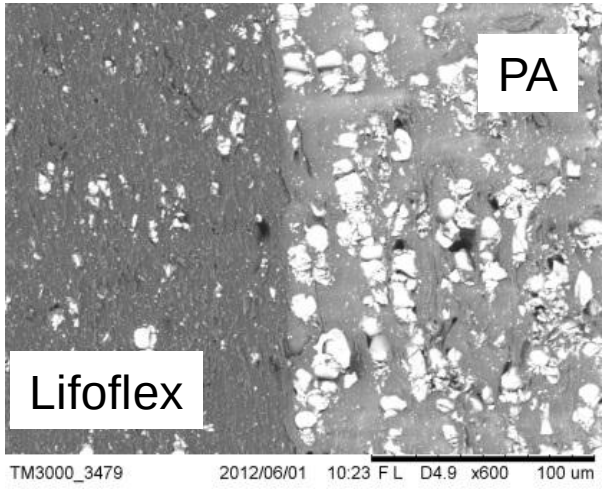


Cutting site of tensile bars for interface investigation

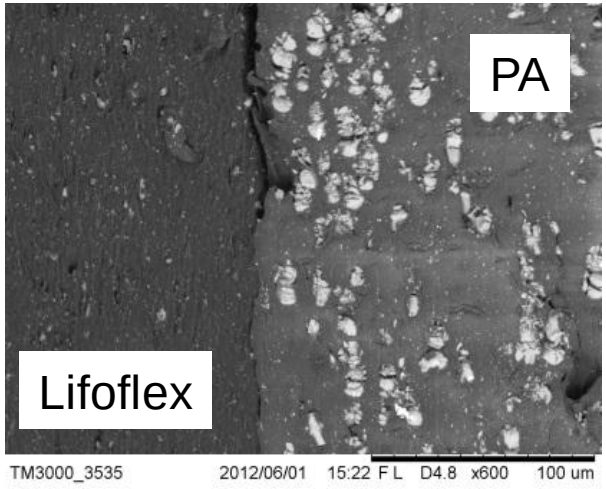
Investigations and Results

Interface: PA - Lifoflex

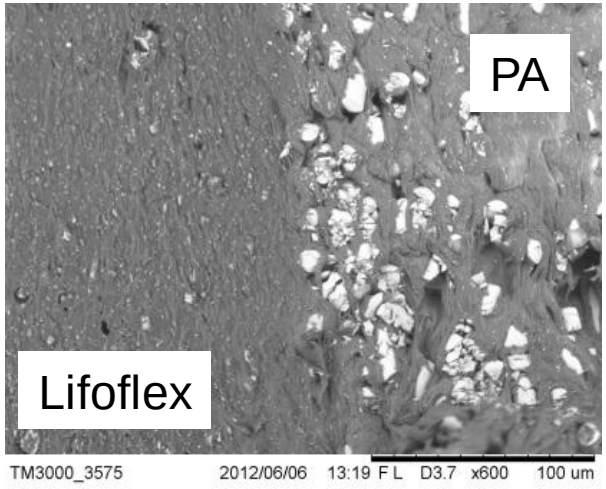
without stand-by time



stand-by time: 5s



stand-by time: 10s

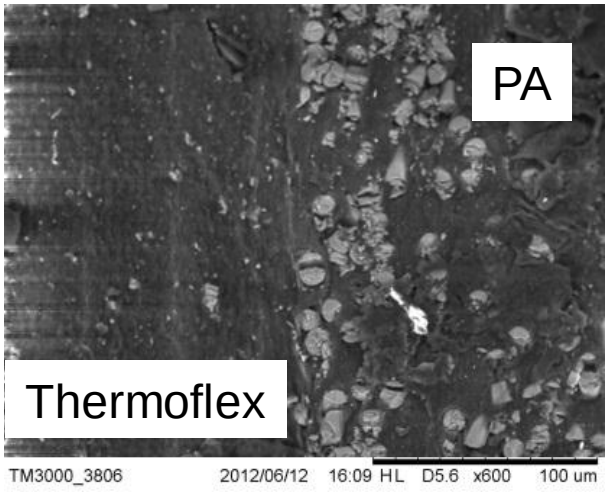


- no significant differences could be determined
- increase of the stand-by time does not show severe anomalies at the interface

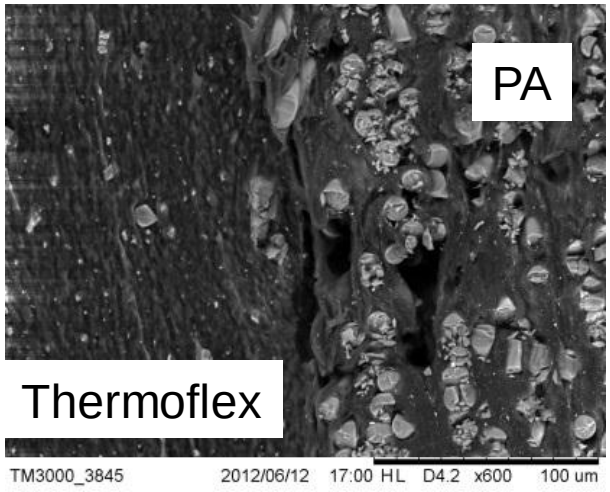
Investigation and Results

Interface: PA – Thermoflex

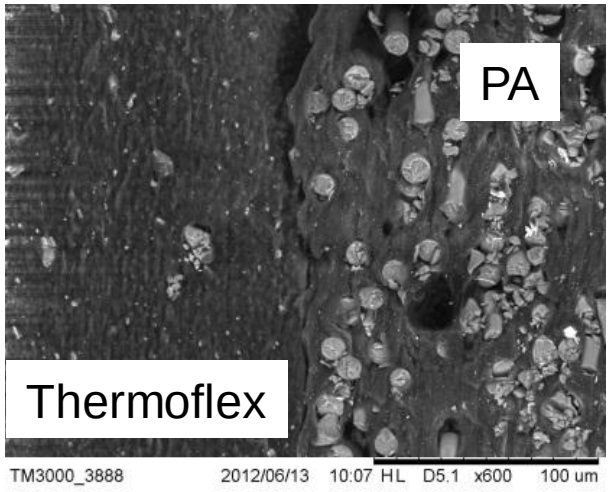
without stand-by time



stand-by time: 5s



stand-by time: 10s

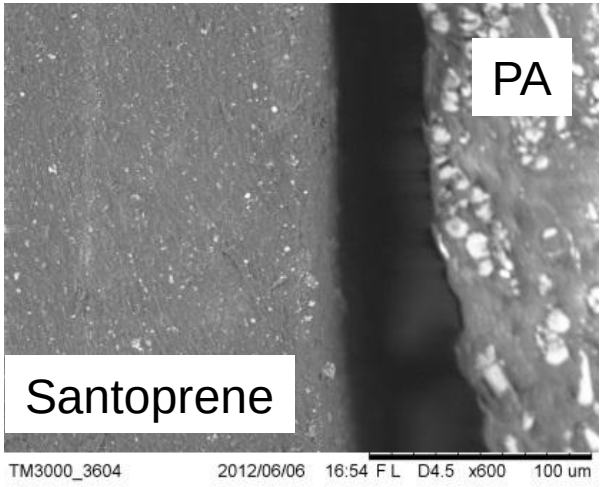


- interface look more discontinuous if the slider was removed after 5s or 10s

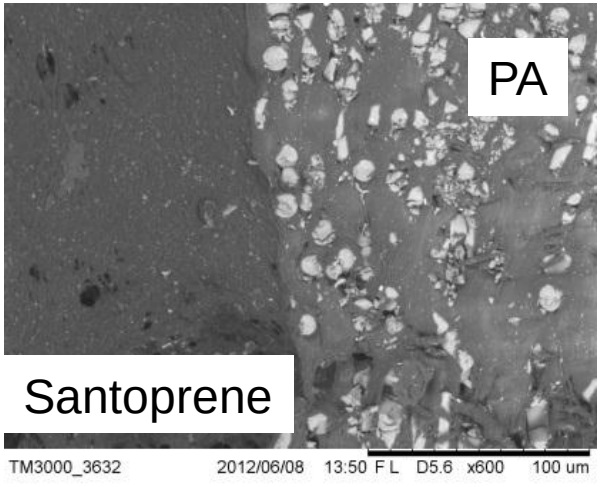
Investigations and Results

Interface: PA - Santoprene

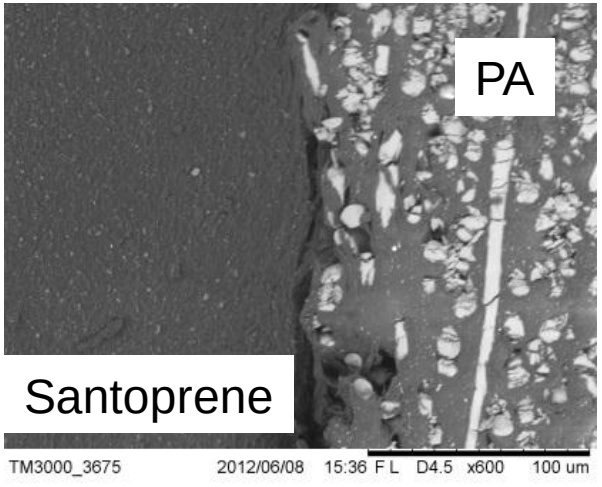
without stand-by time



stand-by time: 5s



stand-by time: 10s



- classic 2C µ-IM: powerful dislocation from the interface; during the cryogenic cut disconnection of the two materials
- using the new 2C-µIM process conduct, however, a certain bonding could be achieved

Summary and Outlook

- the microscopic investigations showed an indefinite characteristic
- on the other hand, this phenomenon seems to depend much more on the particular material pairings than on the way of process conduct

the new 2C-µIM variant shows no significant inferiority compared to classic 2C µ-IM

due to the economic advantages of the new process conduct an increased utilization can be expected

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