



Modeling constitutive and micro-scale frictional behavior of PTFE

Sonne, Mads Rostgaard; Nørregaard, J.; Hattel, Jesper Henri

Publication date:
2013

[Link back to DTU Orbit](#)

Citation (APA):

Sonne, M. R., Nørregaard, J., & Hattel, J. H. (2013). *Modeling constitutive and micro-scale frictional behavior of PTFE*. Abstract from European Congress and Exhibition on Advanced Materials and Processes (EUROMAT 2013), Sevilla, Spain. <http://euromat2013.fems.eu/>

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 you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Modeling constitutive and micro-scale frictional behavior of PTFE

M.R. Sonne^{1*}, J. Nørregaard² and J. H. Hattel¹

¹Technical University of Denmark, Department of Mechanical Engineering, Section of Manufacturing Engineering

²NIL Technology, Denmark

*Corresponding author. Tel: +45 45254734, Email: mrs@mek.dtu.dk, Postal address: Produktionstorvet, Building 425, DK-2800 Kgs. Lyngby

The work presented in this abstract is a part of a larger project called NANOPLAST whose aim is to produce injection moulding tool inserts with nano-structured functional surfaces. With such surfaces, features like antireflective-, hydrophobic- and color-effects will be possible to injection mould directly onto the surface of plastic parts. The nano-structures are transferred to the steel inserts by Nanoimprint Lithography (NIL). As the tool inserts are non-planar 3-D structures, so-called flexible stamps are used for the NIL manufacturing process. Unfortunately, the nano-structures can only be processed onto the flexible stamps in flat 2-D shape. Therefore, in order to create the nano-structures accurately on the curved tool inserts, prediction of the 3-D deformation of the flexible stamps is essential. These predictions are performed using finite element (FE) simulations. Flexible stamps are usually made of a polymer material and in this case polytetrafluoroethylen (PTFE), better known as Teflon, is used. The constitutive behavior of this polymer is prescribed through a 1-D rheological representation consisting of both non-linear visco-elastic and visco-plastic components. The contact between the flexible stamp and tool insert is modeled through standard Coulomb friction; however the contact conditions of PTFE against steel on micro-scale showed to be much more dependent on the actual contact pressure as compared to standard macro-scale observations. The constitutive model was verified through comparison with both experiments found in literature and by in-house performed uniaxial tensile tests. The combination of constitutive and frictional behavior was specifically verified through an experiment, where a PTFE sheet was deformed by a steel sphere mounted in a tensile test machine. Good agreement between simulations and experimental results was found, both regarding force-displacement and corresponding principal strain measurements. As expected, applying the correct frictional behavior between PTFE and steel on micro-scale is shown to be of major importance in order to accurately simulate the strain field in the deformed PTFE stamp.