# Initial stage sintering of polymer particles – modelling size-, temperature- and time- dependent contacts

**T. Weinhart*[1], R. Fuchs[2], M. Ye[2], S. Luding[1], H.-J. Butt[2] and M. Kappl[2]**

[1] Multiscale Mechanics, Engineering Technology, MESA+, University of Twente
PO Box 217, 7500 AE Enschede, The Netherlands

[2] Max–Planck-Institute for Polymer Research, Physics at Interfaces,
Ackermannweg 10, 55218 Mainz, Germany

* e-mail: t.weinhart@utwente.nl, web page: https://www2.msm.ctw.utwente.nl/weinhartt

## ABSTRACT

As additive manufacturing processes such as selective laser sintering are applied to more challenging applications, new printing techniques need to be developed that require a better understanding the sintering kinetics. In particular, the printing of porous structures like polymer scaffolds, which are used to stimulate the formation of new tissue, remains a challenge[1]. In this study, we study the early-stage sintering of thin layers of micron-sized polystyrene (PS) particles with indentation tests to gain a better understanding of the sintering kinetics, in which both surface-flow and viscous forces play a significant role.

To simulate this process with discrete particle simulations, a temperature- and pressure-dependent contact model for sintering is developed. We use the elasto-plastic model of Luding [2] and model sintering by introducing a rate of change for the permanent, plastic deformation at high temperatures. The contact model can simulate both contact sintering as well as compression, i.e., elastic repulsion, *allowing the simulation of sintering and compression in a single simulation framework*. The simulation results for purely viscous sintering agree well with the theoretical predictions, but under-, respectively overpredict, the experimental results for particles below a critical particle radius ($r_{crit}$~1 μm) [3]. Thus, we extend the contact model to account for both surface forces and viscous sintering, as well as the increase in particle radius due to sintering to fully explain the experimental observations.

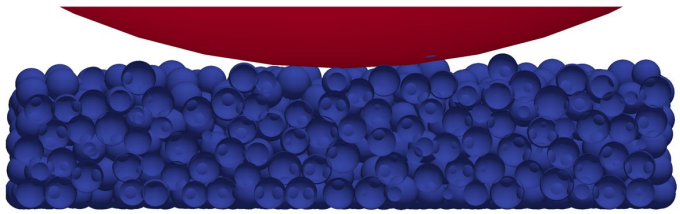

Figure: Vertical cut through center of simulation setup during indentation testing.

## REFERENCES

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