# Local-non-local coupling of Peridynamics correspondence formulation with respect to multiphysical phenomena in Additive Manufacturing processes

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**ABSTRACT**

In the health care industry a patient specific Additive Manufacturing (AM) of cochlea implants is desirable to improve their functionality. Since a comprehensive understanding of the material behaviour (Room Temperature Vulcanisation medical grade silicon) during the printing process does not exist a simulation driven support of patient specific implant development is necessary.

This includes besides the development of a thermochemomechanical coupled large strain curing model the implementation, verification and further development of a suitable meshfree method to accurately predict the extrusion based printing dynamics.

Based on the multiplicative split of the deformation gradient into a mechanical, a chemical and thermal part [1] and an additive split of the free energy into a mechanical and a thermochemical part [2] a large strain curing model is developed. Within this model a process dependent viscoelastic material behaviour is modelled by a further decomposition of the mechanical deformation gradient.

As a numerical solution scheme a meshfree discretisation of an extended version of the Peridynamics correspondence formulation, allowing the application of the developed material model, is used. Due to the nonlocality of the Peridynamics framework a local-non-local coupling is performed for the resulting thermochemomechanical coupled equations.

In the numerical results the performance capability of the extended correspondence formulation regarding the multiphysical problem is shown. This includes the spreading dynamics and solidification of a curing body under gravitational loading and different temperatures as well as material typical behaviour as shrinkage and the release of exothermic heat.

Finally the applicability of the developed framework for the simulation of an extrusion based AM process is presented.

## REFERENCES

[1] Lion A. and Höfer P., "On the phenomenological representation of curing phenomena in continuum mechanics", *Arch. Mech.*, **1**, 59-89 (2007).

[2] Landgraf R., "Modellierung und Simulation der Aushärtung polymerer Werkstoffe",http://nbn-resolving.de/urn:nbn:de:bsz:ch1-qucosa-187720 , (2015).