**Title:** Development of process models for bioconversion (DTFerm)

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**Abstract**:
The conversion of heterogeneous biogenic residues to products such as lactic acid is considered a key step towards a sustainable production of bio-based materials, but the heterogeneity of the starting materials is still challenging an optimal control of bioconversion (Olszewska-Widdrat et al. 2019, 2020). Accordingly, the goal of this research project is to support optimization of bioconversion for heterogeneous starting matrices by the development and analyses of mathematical process models that consider both, biochemical transformation processes and the dynamics of the transforming biomass (Wang et al. 2020). The development of process models for bioconversion is an iterative process with the ultimate goal to design and optimize bioconversion processes that are efficient, economically viable, and environmentally sustainable. Examples from environmental microbiology can serve as blueprint for such process model development (Schauss et al, 2009).

In a possible next step, the calibration of the process models is to be extended to using online measurements of crucial process variables, to allow the continuous virtual representation of batches of starting materials. Such close coupling of process modeling and online data collection and use comes close to the definition of a digital twin. In a final step, these process models will then be coupled with data-based models in order to optimize process control and to address the specifics of the starting substrates. The combination of this project with other KIDS methods is possible, e.g. for process optimization/control or for data-driven model approaches. This project is related to overarching themes digital twins/process control.

**Desired skills of the applicant:**
*Required*: Mathematical modelling (e.g. differential equations, model calibration), interest in biological and chemical data and methods to generate those

*Optional:* AI/data-driven modelling, multivariate statistics, concrete knowledge /experience on chemical /biological process engineering

**References**:
Schauss K, Focks A, Leininger S, Kotzerke A, Heuer H, Thiele-Bruhn S, Sharma S, Wilke BM, Matthies M, Smalla K, Munch JC, Amelung W, Kaupenjohann M, Schloter M, Schleper C. Dynamics and functional relevance of ammonia-oxidizing archaea in two agricultural soils. Environ Microbiol. 2009 Feb;11(2):446-56. doi: 10.1111/j.1462-2920.2008.01783.x. PMID: 19196275.

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