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GAS-PHASE BIOREACTORS FOR THE 21ST CENTURY: POSSIBILITIES AND LIMITS

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Biological systems have a fantastic potential for the biotransformation of a wide range of substances. While the vast majority of biological processes are conducted in suspended liquid cultures, there is increasing interest in gas-phase bioreactors in which biotransformations are mediated by biofilms attached on supports and where substrates are provided via the gas phase. This mode of operation opens new possibilities in green chemical processing and environmentally friendly bioprocesses for pollution control. Very intense processes can be devised because of reduced mass transfer resistances in the gas phase. In this talk, I will present and discuss several projects currently ongoing in my lab. These include biogas upgrade (CO_2 conversion to methane) using hydrogenotrophic methanogens in biotrickling filters, with simultaneous removal of H_2S. Another novel application is the development of microbioreactors for the treatment of volatile organic compounds (VOCs). These systems may be used for indoor air pollution control in conjunction with microconcentrators (developed separately). We have developed microbioreactors, either 3D printed microstructures or microcapillaries (diameter, 1 mm), in which extremely high gas-liquid mass transfer coefficients and VOC biodegradation rates orders of magnitude greater than in conventional bioreactors were observed. Implications for practical applications, challenges, and opportunities for such bioreaction systems will be presented and discussed.