Understanding the role of stress in synthetic biology

S. Snoeck, M. De Mey
Centre for Synthetic Biology, University of Ghent

Industrial biotechnology is gaining more and more interest in view of the replacement of wasteful and harsh chemical processes, especially in the manufactory of naturally derived products. A plethora of tools has already been developed over the last decades to engineer microbial organisms, which enabled the design of some industrially interesting strains. However, to access the full potential of microbial production, a major bottleneck is yet to be conquered. This bottleneck is the metabolic stress that is imposed on microbial cells when expressing synthetic constructs. Extra genes, new metabolites and unbalanced metabolic fluxes are a burden to the cell and cause decreased growth rates and cell viability. As a consequence, predicted yields are not met, prohibiting biotechnological processes to be economically viable. It is therefore of utmost importance to gain more insight in the triggers of these stress responses and their regulation. This would provide opportunities to develop stress-resistant strains that can result in the necessary yield to be economically viable and competitive.
Omics techniques are very interesting in this regard as they can give an overview of what is happening to cells when they are under stress. It can give insight in changes in e.g. metabolite abundances (metabolomics) and the up- or down-regulation of genes (transcriptomics). This information will provide an indication of where the bottlenecks are situated and thus serve as a basis for engineering decisions.