

MICROBIAL SYNTHETIC BIOLOGY

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In this talk, I will introduce two topics related with microbial engineering; a novel synthetic biology tool for efficient protein synthesis and a novel microbial platform for biorefinery. Firstly, we developed a synthetic Protein Quality Control (ProQC) system to improve the yield of the synthesis of full-length proteins in *E. coli*. Tightly coupled transcription and translation system in prokaryotes can cause the production of non-functional polypeptides which are translated from early-terminated or degraded transcripts. We used toehold switches to decouple transcription and translation processes. By placing corresponding trigger sequences at 3'-end of mRNA, intact full-length mRNAs could only be translated. When fluorescence tags were attached at both N- and C-terminal ends, we found that equivalent fluorescent intensities from both ends were observed in our system. This result shows that decoupling of transcription and translation processes can be applicable to elevate the quality of gene expression, especially longer proteins. Secondly, we isolated a novel fast-growing bacterium which shows efficient alginate utilization and whose growth rates and sugar uptake rates with most biomass-derivable sugars are substantially higher than those of *E. coli*. We systematically characterized its genome as well as transcriptome to elucidate its metabolism and gene expression architecture. Based on this, we were able to develop genetic toolboxes for its engineering and successfully demonstrated rapid production of a broad spectrum of chemicals (ethanol, 2,3-butanediol, and lycopene) from alginate and mannitol mixtures with high productivities and yields. Collectively, this strain is a powerful platform for conversion of brown macroalgae sugars; moreover, its usage will dramatically accelerate production of value-added biochemicals.