

Synthetic Biology: Genetic code expansion for bioenergy production

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Despite all the technical progress, our ability to rationally manipulate the structures and functions of proteins is quite limited, because the genetic code specifies the same 20 amino acids building blocks. The development of a method that makes possible the systematic expansion of the genetic code can enable the evolution of proteins with new or enhanced properties. Recent advances in engineering of translation machinery have made it possible to add over 30 novel amino acids to the genetic code, but the repertoire of unnatural functional groups is still limited and their application is quite restricted. In an effort to overcome these major obstacles, newly discovered aminoacyl tRNA synthetase and tRNA were characterized in terms of structure and biochemical properties. Based on these studies, the cellular translation system was redesigned and evolved to site-specifically incorporate novel unnatural amino acids. Direct incorporation of unnatural amino acids can make considerable contribution to biotechnology and bioenergy research areas such as protein engineering, click chemistry, and nanobiotechnology, and bioenergy production. Detailed experimental design and results will be presented and application of synthetic biology technology will be discussed.