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Streptomyces are attractive microbial cell factories that have industrial capability to produce a wide array of bioactive secondary metabolites. However, the genetic potential of the Streptomyces species has not been fully utilized because most of their secondary metabolite biosynthetic gene clusters (SM-BGCs) are silent under laboratory culture conditions. In an effort to activate SM-BGCs encoded in Streptomyces genomes, synthetic biology has emerged as a robust strategy to understand, design, and engineer the biosynthetic capability of Streptomyces secondary metabolites. In this regard, diverse synthetic biology tools have been developed for Streptomyces species with technical advances in DNA synthesis, sequencing, and editing. Here, we review recent progress in the development of synthetic biology tools for the production of novel secondary metabolites in Streptomyces, including genomic elements and genome engineering tools for Streptomyces, the heterologous gene expression strategy of designed biosynthetic gene clusters in the Streptomyces chassis strain, and future directions to expand diversity of novel secondary metabolites.