Biosynthesis of inorganic nanomaterials and their applications

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Nanomaterials are mostly synthesized by chemical and physical methods, but biological synthesis is also receiving great attention. Recently, wild-type and genetically engineered microorganisms can be used as biofactories to produce various inorganic nanomaterials. Here we report biosynthesis of 60 different inorganic nanomaterials by employing a recombinant Escherichia coli strain co-expressing metallothionein and phytochelatin synthase. The periodic table was scanned to select 35 suitable elements using the recombinant E. coli cell, followed by biosynthesis of their nanomaterials. Based on the Pourbaix diagram analyses, the initial pH of reactions was changed from 6.5 to 7.5, resulting in biosynthesis of crystalline inorganic nanomaterials of those previously amorphous or not synthesized ones. Moreover, we have been utilized biogenic inorganic nanomaterials and their hybrids for some applications, including gas sensor, bio-imaginable drug-delivery system, and valuable chemical production. In particular, biosynthesized inorganic nanomaterial-microorganism biohybrid was developed to produce ammonia under ambient conditions.