# Synthesis of pyrite nanoparticles using organic molecules from *Chrysomallon squamiferum*

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[Background] *Chrysomallon squamiferum* (scaly foot) is a deep-sea snail which was discovered near the hydrothermal vent of the Central Indian Ocean Ridge "Kairei Field". This snail has scaly structures mineralized with iron sulfide nanoparticles (pyrite, $FeS_2$) on its foot, and the shell is covered with an iron sulfide layer on the calcium carbonate layer. Pyrite nanoparticles have superior photovoltaic properties to be applied to photovoltaic power generation in the solar panel. However, the methods of its inexpensive and green chemical synthesis have not been established. Therefore, new industrial applications using the formation mechanism of pyrite nanoparticles in the scaly foot are required. In this research, in order to identify the substances that have key factors to synthesize pyrite nanoparticles *in vitro*, we tried to extract the organic molecules that bind to iron in the sacly foot, because the iron-binding organic molecules may have a function to prevent the aggregation of particles.

[Abstract] In this study, we analyzed the organic molecules extracted from the scaly structure and the shell in the scaly foot and searched for substances related to the production of iron sulfide nanoparticles by interaction with iron.

Pyrite in the scaly structure was dissolved by reducing with zinc and trivalent chromium under anaerobic conditions. We used HPLC post column chelator method to identify the iron binding organic molecules. This result revealed that large amount of low molecular weight organic matters having iron binding ability existed in the scaly structure. This low molecular weight organic molecule was purified using cation exchange resin and reverse phase-HPLC. We tried to determine its chemical structure using mass spectrometry and NMR.

On the other hand, 1 M acetic acid was used to dissolve the calcium carbonate layer of the outer shell. Then, the insoluble iron sulfide layer in acetic acid was extracted using SDS-DTT. A specific protein band was detected from the iron sulfide layer. LC-MS/MS analyses revealed that this band showed an amino sequence of heme protein. Heme is consisting of tetrapyrrole ring that can make the complex with iron *in vivo.*

The heme protein may have some roles for the formation of nano pyrite *in vitro*. We try to use the heme protein to synthesize pyrite nanoparticles using various conditions.

Keywords: *Chrysomallon squamiferum*, Heme proteins, pyrite nanoparticles

 