Biocatalytic nanosilica synthesis

Aleksandra Pieła

The objective of this study was to apply a biorefining strategy to the synthesis of structured forms of silica by biotransformation of waste plant biomass by filamentous fungi.

A rice husk biotransformation reaction protocol was developed using *A. parasiticus* as a biocatalyst to yield 5.2 mg of silica per liter of biotransformation fluid on the 11th day of the process. It was verified that the synthesized silica nanoparticles assumed a pyramidal form with a side length of about 400 nm and a spherical form with dimensions of 24 ± 8 nm on the substrate surface. In the ashed biotransformation fluid, they adopted a cubic form with an average size of 85 nm and a spherical form with an average size of 3 nm.

A protocol for the biotransformation reaction of corn cobs husk using *F. culmorum* was also developed, which allowed for a silica concentration of 5.9 mg/L in the post-biotransformation fluid as early as the 7th day of the process. Spherical silica nanoparticles with sizes of ~40 and ~70 nm were obtained in the post-biotransformation fluid. There were no nanoparticles observed on the substrate surface.

It was demonstrated that the culture method of the biocatalyst and the substrate preparation method were crucial for the processes. Additionally, the fungal preference for the form of silicon found in the plant and the role of fungal intracellular and extracellular proteins in the biotransformation process were determined. The scale of the process was also enlarged and nearly three times higher silica concentration in the biotransformation fluid was obtained compared to the preparative scale. It was verified that the intracellular proteins of the biocatalyst participate in the degradation of the plant substrate thus facilitating the access of extracellular proteins to the silica contained therein and subsequent transformation to spherical nanoparticles.