Biomimetic growth of silica with controlled aspect ratios and relevance to biosilification

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Diatom is well known for the intricate design of its silicified cell wall (termed frustules). During the past decades, various biological and organic molecules have been successively separated and identified from cell-wall extracts of diatoms, and many efforts have focused on exploring how these organic components influence biosilica morphogenesis. Recently, XPS and solid state NMR analyses on diatom cell-walls revealed the intimate association of phospholipids with biosilica structures. Moreover, all genera of diatoms investigated so far can incorporate polyamines into their silicified cell-walls, and phase separation model based on the organic amines is considered to be responsible for the porous nanopatterning of biosilica. Nevertheless, some other nanometer-scale details, such as non-spherical siliceous structures differentiating in specific directions are also displayed in the late stages of frustule development and their growth mechanisms are not well understood. Herein, dodecylamine and phospholipid were selected as model organic additives, and their phase separation was initiated to influence silica deposition. The experimental results show that the phase separation of the organic components not noly leads to the appearance of asymmetrical silica particles, but also their aspect ratios can be well adjusted by altering the concentrations of dodecylamine and phospholipid. Therefore, our results may indicate that the growth differentiation of siliceous structures in diatoms can be genetically triggered through diatom secreting organic amines and lipids, and hence provide a new insight into biosilicification mechanism.

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