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The synthetic opal fixed in hydrothermal environment

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Opal shows a characteristic opalescence by periodic stacking of amorphous silica spherules with several hundred nanometers in diameter. The amorphous silica spherules can be synthesized by the Stoeber method with hydrolysis of tetra ethyl orthosilicate (TEOS) solution. The initial silica spherules are dispersed in suspension. In this study, we report stable synthetic opal with opalescence domains fixed in hydrothermal conditions.

The silica spherule suspension made by the Stoeber method is concentrated and poured in silica glass test tube with 6mm in inner diameter and approximately 30mm in height. The silica test tubes are sealed in teflon crucibles or microreacters with distilled water and heated to 100 degrees Celsius - 250 degrees Celsius for 1 to 75 days. Depth of distilled water outside the silica glass test tubes does not exceed the height of the test tube. After the run durations, surface of the settled silica is covered with resin and cut to observe vertical section by optical and electron microscopes.

In the run products of 100 degree C to 200 degree C, we can see opalescence domains up to mm scale. Especially, in the run products of 200 degree C, we can see development of opalescence domains with various colors. Under the electron microscopy, deformation of silica spherules or cementation is observed in run products with opalescence. The hydrothermal environment can play essential role to form opalescence domains and fixation from amorphous silica spherule suspension.

Keywords: opal, hydrothermal synthesis, opalescence domain, amorphous silica