Research Introduction

Study of Dynamic Pattern Formation of Precipitation Bands

Okano laboratory

Ionic Crystal

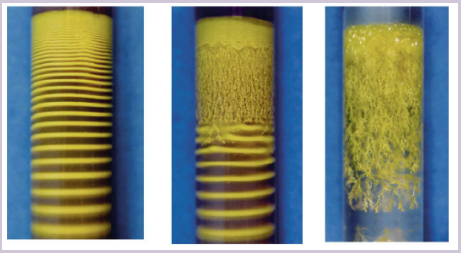
WATER SOLUTION

NaOH

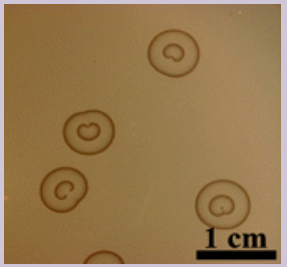
Alums

$CuSO_4$

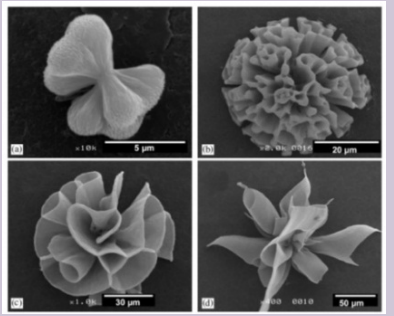
GEL SOLUTION



CuI



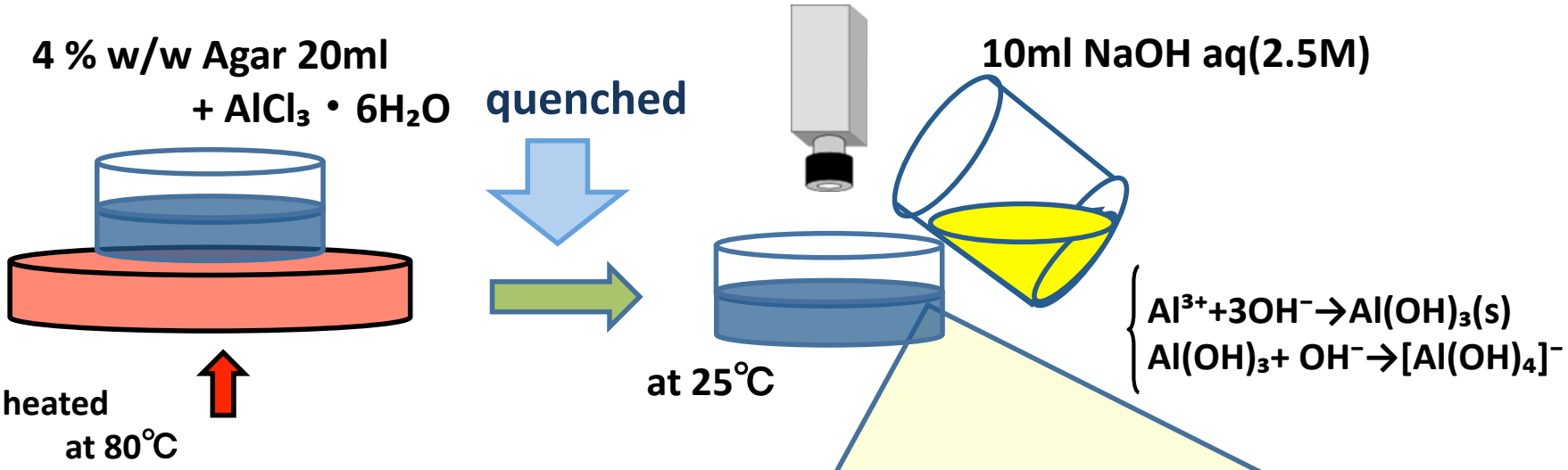
$Al(OH)_3$



$SrCO_3$

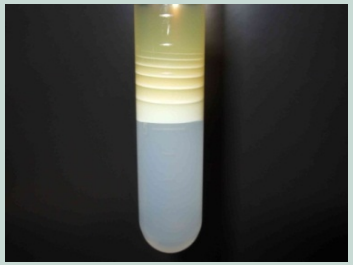
Study about crystal growth in Gel solution!!

Experimental method



Formation pattern

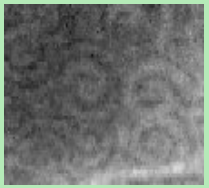
Side view



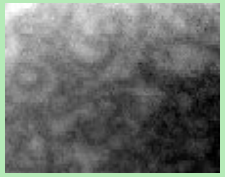
Top view

ring

Double spiral



spiral



collapse

turbulence

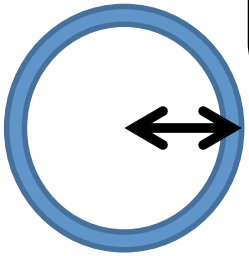
Result

$AlCl_3 \cdot 6H_2O$ [mol/l]	Quench temperature [℃]						
	10	15	20	25	30	35	40
0.20							××× ××
0.23	××× ××	××× ××	××× ××	××× ××	××× ××	××× ××	○○○ ○○
0.25	○○○ ○○	○○○ ○○	○○○ ○○	○○○ ○△	○○○ △△	○○○ △△	○○△ △△
0.28	○○○ △△	△△△ △△	△△△ △□	△△△ △△	△△△ △△	△△△ △△	△□□ □□
0.30	△△△ □□	△□□ □□	△△□ □□	△□□ □★	△□□ □□	□□□ □□	□★★ ★★
0.33	□□□ □□	□□□ □□	□□□ □□	□★★ ★★	□★★ ★★	★★★ ★★	★★★ ★★
0.35	★★★ ★★	★★★ ★★	★★★ ★★	★★★ ★★	★★★ ★★	★★★ ★★	★★● ●●
0.38	●●● ●●	●●● ●●	●●● ●●	●●● ●●	●●● ●●	●●● ●●	●●● ●●
0.40	●●● ●●	●●● ●●	●●● ●●	●●● ●●	●●● ●●	●●● ●●	●●● ●●

NaOH = 2.5M
Gel Temperature at 25℃

×:no reaction
○ :ring
△ :double spiral
□ :spiral
★ :collapse
● :turbulence

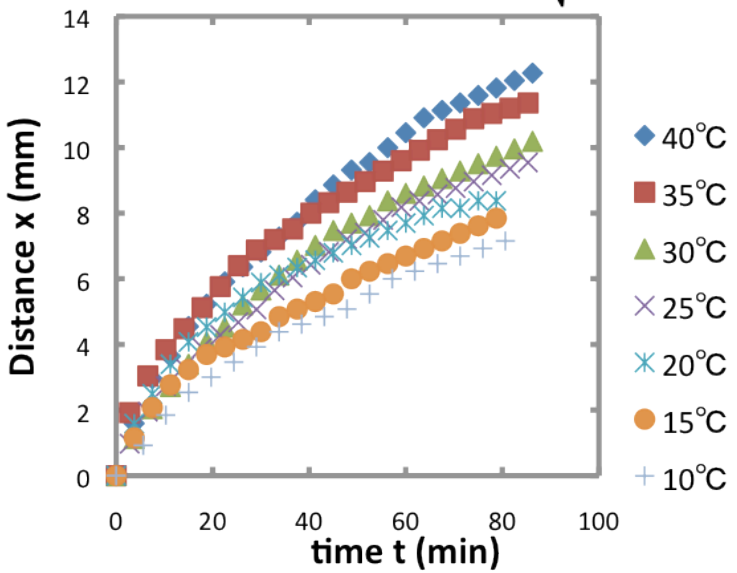
Ring pattern

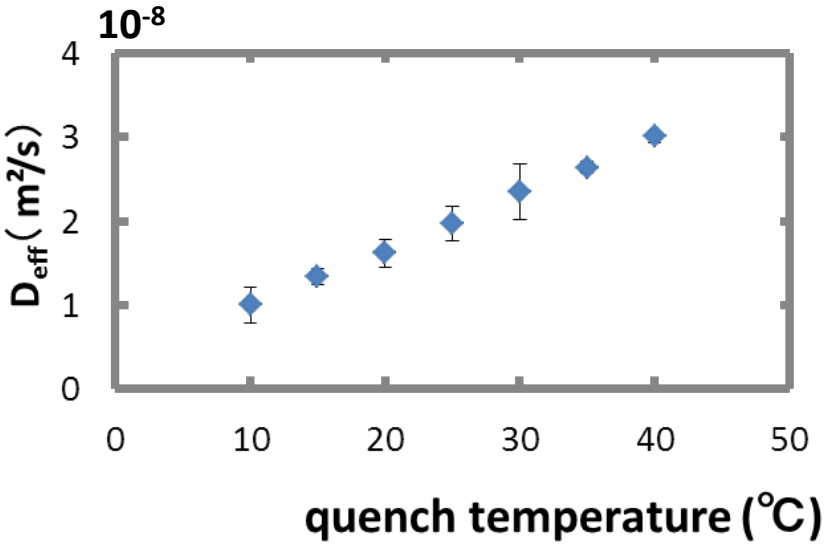


- $AlCl_3$(0.25M)
- NaOH(2.5M)

Measure distance each time from arising the precipitation

$$x = \sqrt{D_{eff}.t}$$



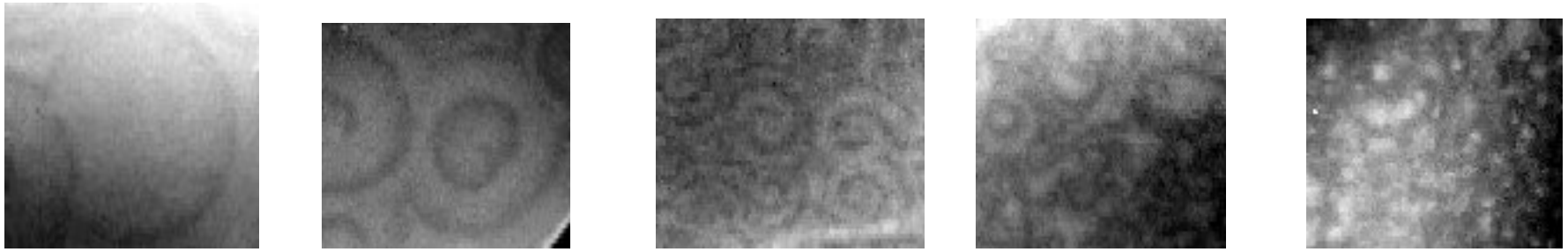


As quenched temperature is increased, the effective diffusion coefficient of precipitation band is larger in a ring pattern

Formation pattern

Top view

ring | Double spiral | spiral | collapse | turbulence



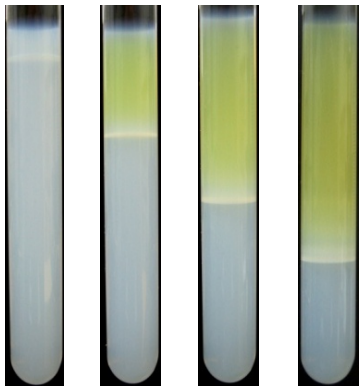
Increase in concentration of Al^{3+}

Decrease in concentration of OH^-

Quench Temperature of Gel (Higher)

Numerical Analysis

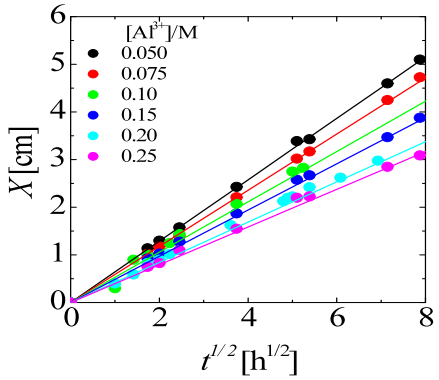
Side view

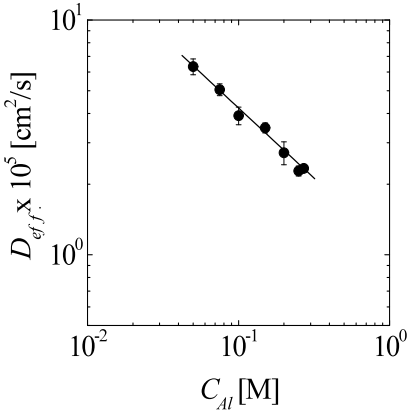


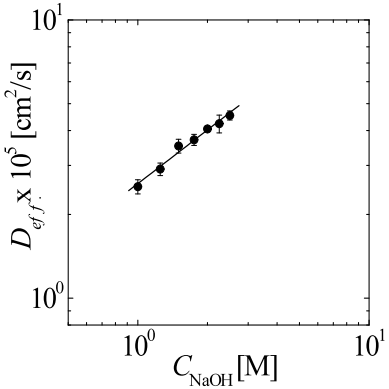
Moving distance X

Time t

Experimental results

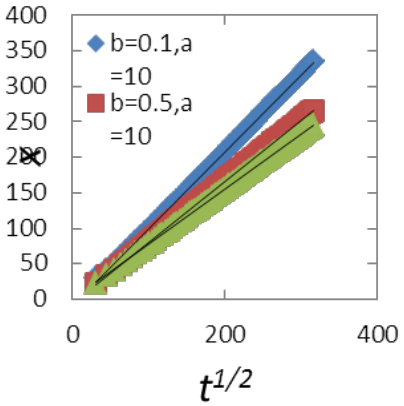


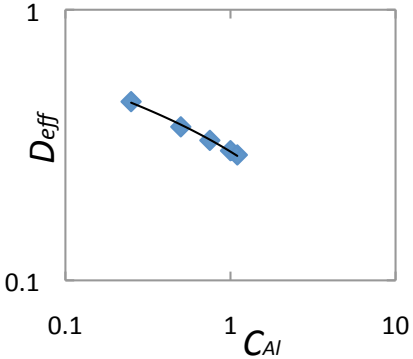




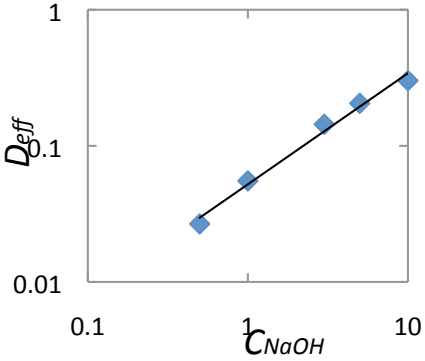
Numerical analysis

Numerical results





- Effect of Inner Electrolyte, Al^{3+}



- Effect of Outer Electrolyte OH^-

Corresponds with experimental analysis