

High Functional Nano-sensors and Nano-materials

Size-controlled metallic Fe nano-particles

Department of Materials Science & Engineering
Nagoya Institute of Technology Professor Kenji Sumiyama

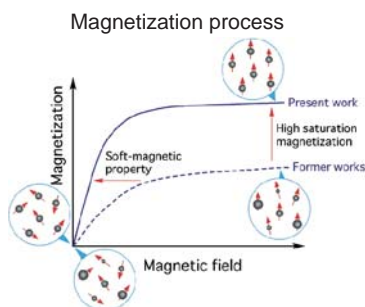
Objective

1. Fabrication of size-controlled Fe nano-particles, whose magnetization are large and easily saturated.
2. Technical application of Fe nano-particles.

Powerful ferromagnetic fluids
(improvement of particles' magnetization and density)



Instrument down sizing
(quick response to weak magnetic field)



Comparison of magnetization

	Fe nano-particles	Fe oxide nano-particles
present	860	370
goal	1200	—
theory	1710	470

unit:gauss

Results

1. Preparation of monodisperse size Fe nano particles

Patent submitting

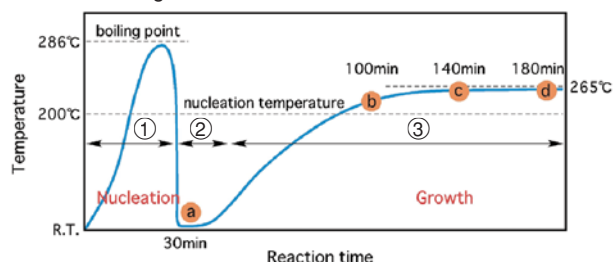
- ① Reduction of an organometallic compound solute in an alcohol solution at high temperature, and formation and rapid cooling of crystal nuclei.
- ② Reheat of an alcohol solution containing crystal nuclei and an additional organometallic solute.
- ③ Crystal growth through a certain duration time.

2. Magnetic properties of monodisperse size Fe nano-particle

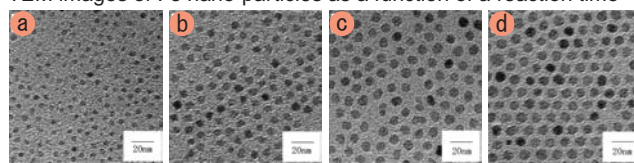


Movement of ferromagnetic fluid toward a small magnet

Recipe : seeded growth independent controls of nucleation and growth



TEM images of Fe nano-particles as a function of a reaction time



Industrial applications

1. Compact size ferromagnetic fluid seal (bearing, sealing, spindle motor)
2. Drug delivery sensitively controllable by applied field
3. High performance magnetic sensor (gradient, acceleration, vibration)

