



Size modification and coating of Titania(TiO₂) by H₂/Air premixed flame

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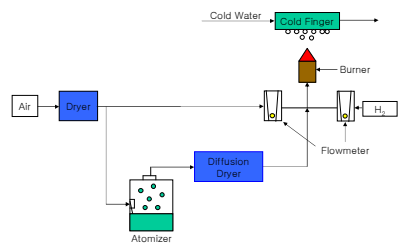
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RESEARCH MOTIVATION

High-performance pigment requires particles with cohesive and compact coatings.

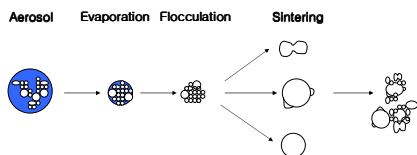
- Titanium dioxide pigments are commonly used in paint and paper. Normally, coatings on titanium dioxide are used to improve dispersion and pigment durability (reduce photo-activity), and to resist increasing viscosity in aging paint.
- Cohesive and compact coatings result in improved durability and lower oil adsorption.
- A continuous, high temperature, gas phase synthesis process can be an alternative to liquid phase routes. Liquid phase coating methods can be complicated and expensive, and may result in porous coatings and high oil absorption.

EXPERIMENTAL PROCEDURE



Schematic diagram of the experiment

THEORETICAL BACKGROUND



Schematics of the sintering process of TiO₂

- Coalescence rate

$$\frac{da}{dt} = -\frac{1}{\tau_f} (a - a_{sph}) \quad \tau_f = \frac{3kTv}{64\pi D\sigma v_m}$$

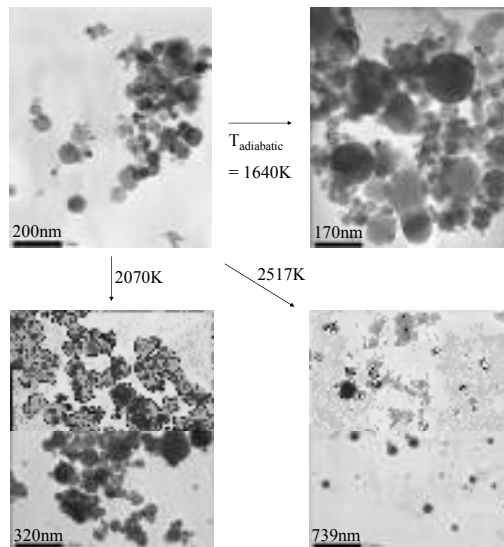
- Diffusivity

$$D = D_0 \exp\left(-\frac{Q}{RT}\right) \quad D_0 = \text{Frequency factor} \quad Q = \text{Activation energy}$$

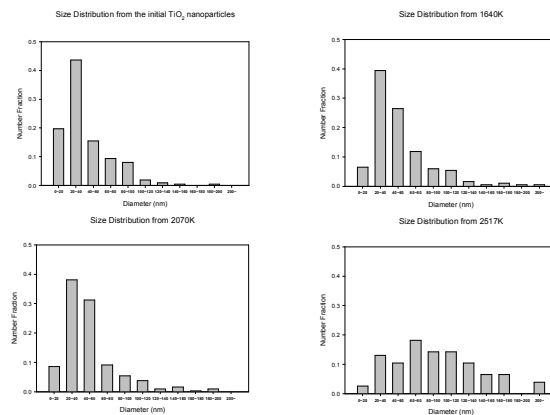
- Atomic diffusion (under the melting point)
RANDOM thermally-activated jumping of atoms into vacancies results in the net transport of atoms.

EXPERIMENTAL RESULTS

Part I. Size modification of TiO₂

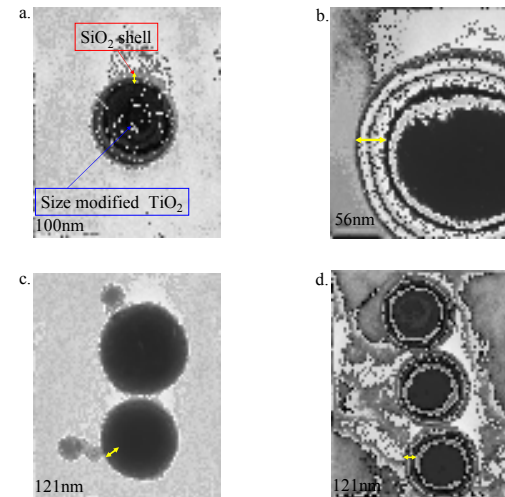


TEM (Transmission Electron Microscope) results of Size modified Titania particles

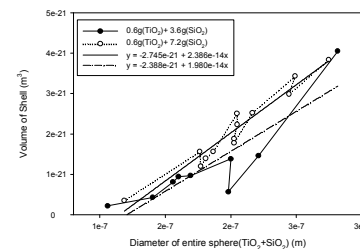


Size Distribution from TEMs

Part II. Generating SiO₂ coated TiO₂ particles



TEM results of SiO₂ coated Titania particles a. and b. from 0.6g(TiO₂)+3.6g(SiO₂), c. and d. 0.6g(TiO₂)+ 7.2g(SiO₂) *Adiabatic Flame Temperature : 2385K



CONCLUSIONS AND FUTURE WORK

- We modified the TiO₂ particle size distribution by controlling the Temperature of H₂/Air laminar flame.
- A controlled SiO₂ coating was produced by atomizing a solution of colloidal SiO₂ and TiO₂, and passing droplets through a Hydrogen/Air flame.
- The thickness of SiO₂ shell was dependent on SiO₂/TiO₂ mass ratio in the solution.
- Future work: Adjusting process parameters to find conditions leading to **smooth controllable SiO₂ coatings**.