Thermal treatment and crystallization conditions of Yttrium Orthoferrite materials

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INTRODUCTION

•**$YFeO_3$** : Applications[1]:

-Sensors -Magneto-optical devices

-Solid oxide fuel cells -Catalyst (BG= 2,37eV[2])

•Catalyzed reaction : **water splitting**

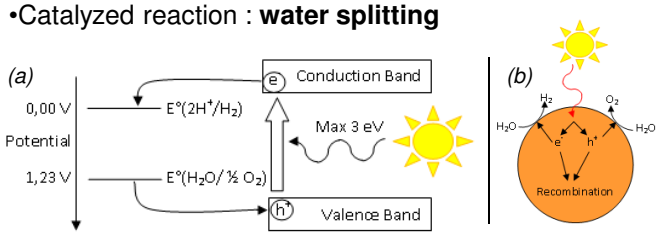


Figure 1: Principles (a) and processes (b) of water splitting using a semiconductor photocatalysts

TECHNIQUE : Dip-Coating

Process

1) Substrate immersion
2) Deposition and removal
3) Drain
4) Solvent evaporation
5) Stabilization

Parameters

•Substrate
•Dipping/Removal speed
•Relative humidity
•Stabilizing temperature

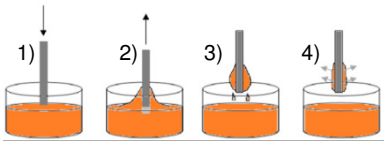


Figure 2: The different stages of the dip-coating method

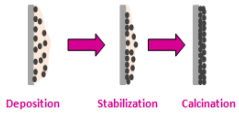


Figure 3: Particles repartition at different temperatures

RESULTS & DISCUSSIONS

Powders:

Synthesis

$Y(NO_3)_3 + Fe(NO_3)_3$

↓ (+ chelating agent) + NH_4OH

$Y(OH)_3 + Fe(OH)_3$ precipitate

↓ + HNO_3

$YFe(O)_x(OH)_y$ gel

↓ 80°C, overnight Combustion, 2h

$YFeO_3$

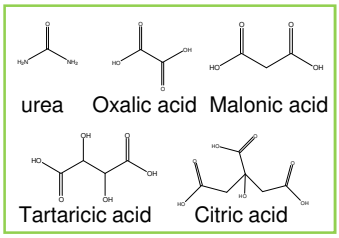


Figure 4: Chelating agent

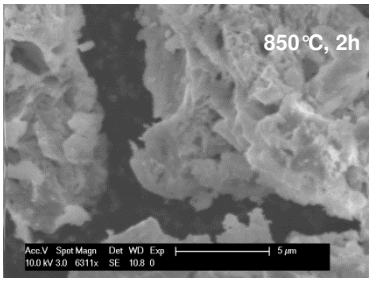
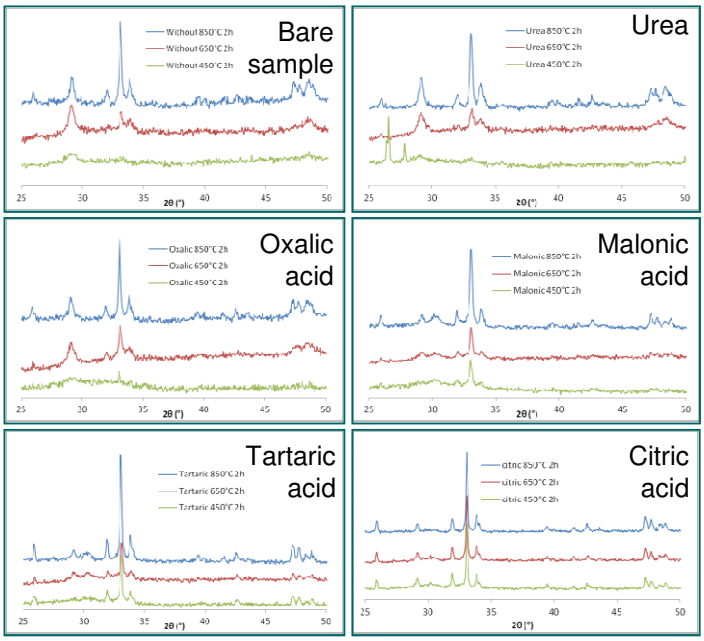


Figure 5: SEM image of $YFeO_3$ powder calcinated at 850°C 2h

XRD & THERMAL ANALYSIS



Thin films

Synthesis: same as powder until $YFe(O)_x(OH)_y$ gel → 1) dip-coating 2) calcination → $YFeO_3$ Thin film

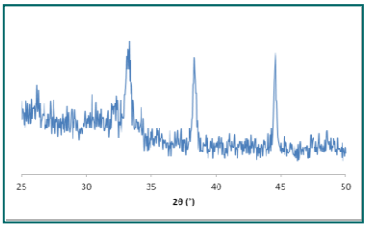


Fig 6: XRD of $YFeO_3$/Si calcinated at 850°C during 10h

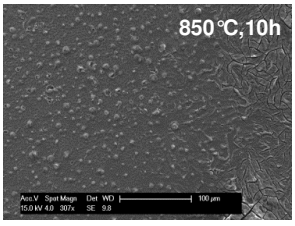


Fig 5: SEM image of calcinated $YFeO_3$/Si

Conclusions

✓Successfully synthesize $YFeO_3$
→Crystallization temperature: 850°C

✓Successfully crystallize $YFeO_3$ on monocrystalline Si

At 850°C, TCO melts…

→ Need to reduce the crystallization temperature

✓Chelating agent are useful
→best one = **Citric acid**

[1] Rajendran, M., Ghanashyam Krishna, M., Bhattacharya, A.K., Low temperature preparation of orthoferrite thin-films by an inorganic sol-gel process. *Thin Solid Films* **2001**, 385, 230-233.

[2] Tang, Peisong; Sun, He; Chen, Haifeng; Cao, Feng, Hydrothermal Processing-Assisted Synthesis of Nanocrystalline YFeO3 and its Visible-Light Photocatalytic Activity, *Current Nanoscience*, Vol 8, Num 1, Feb 2012 , pp. 64-67(4)