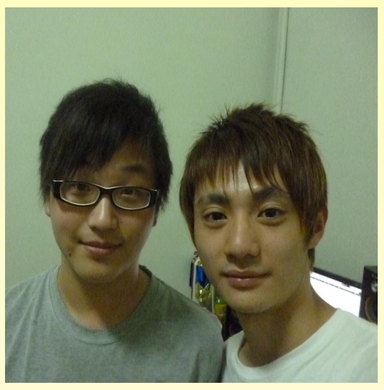
101年大學部國際交流甄選專題成果展



Thin Film of Perovskite BCZY Oxide Synthesized by Electrochemical Deposition

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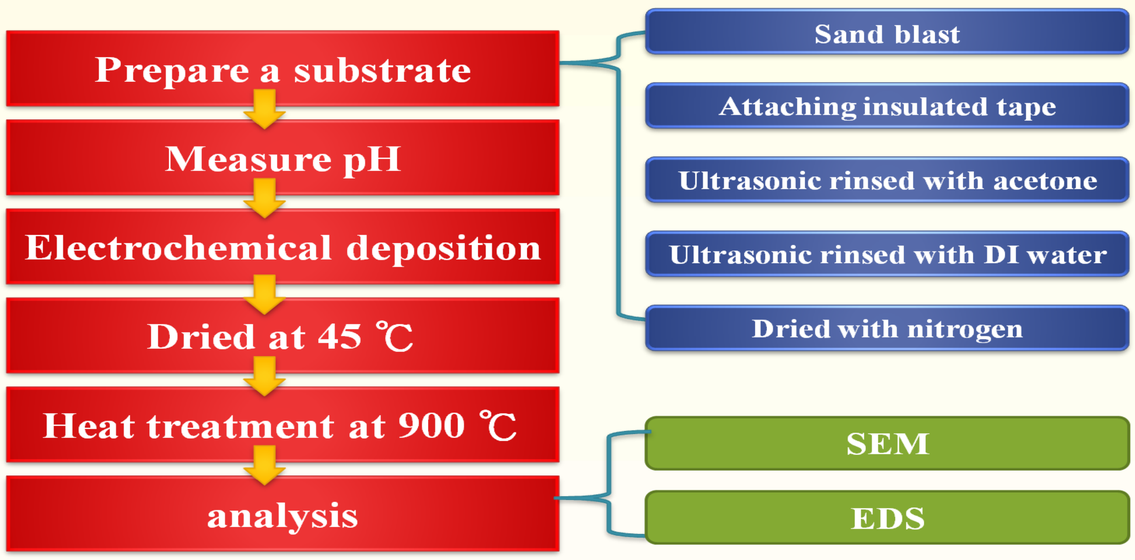
Abstract

This research used electrochemical method to obtain the uniform thin film of perovskite BCZY($BaCe_{0.6}Zr_{0.2}Y_{0.2}O_3$)oxide. It can be adapted as a simple route to the synthesis of perovskite oxide coating on conducting substrate. We used electrochemical deposition by cathodic reduction of mixed-metal nitrate solution to get the hydroxide precursor and did the heat treatment to obtain the perovskite oxide. By varying with different parameters to find out the better coating. Then, analyzed by Scanning Electron Microscopy and Energy Dispersive Spectrometer to see the coating on substrate and the atom ratio .

Experimental Procedures



Experimental Parameter

Variation with substrate, pH, current density, time ,and surface treatment shows on table 1. The fixed electrolyte concentration lists in table2 .

Table 1. Experimental parameter

Substrate	pH	Current density	Deposition time	Surface treatment
Stainless steel	2.0	2.5 mA/cm²	1 h	None
Aluminum	2.5	5.0 mA/cm²	2 h	Sand blast
Copper	3.0	7.5 mA/cm²		

Table 2. Electrolyte concentration

Electrolyte concentration	
Barium nitrate	0.071 M
Cerium nitrate	0.043 M
Zirconium nitrate	0.014 M
yttrium nitrate	0.014 M

Results and Discussions

Table 3. The parameter with the more uniform coating

Deposition parameters	
Substrate	Copper
Surface treatment	Sand blast
pH	3.0
Current density	2.5 mA/cm²
Deposition time	1 h

- The coating is more uniform with the higher pH of electrolyte.
- Current density choose as 2.5 mA/cm² to prevent the coating falling down by too fast deposition.
- Surface treatment with sand blast is needed to increase the surface roughness.
- The copper samples appear the more uniform then the stainless steel samples .The aluminum substrate is not workable because it is etched by solution .

Figure 1. Picture of the hydroxide precursor with best deposition condition

Figure 2. Picture of the thin film of perovskite oxide with best deposition condition after heat treatment at 900 ℃

➢SEM

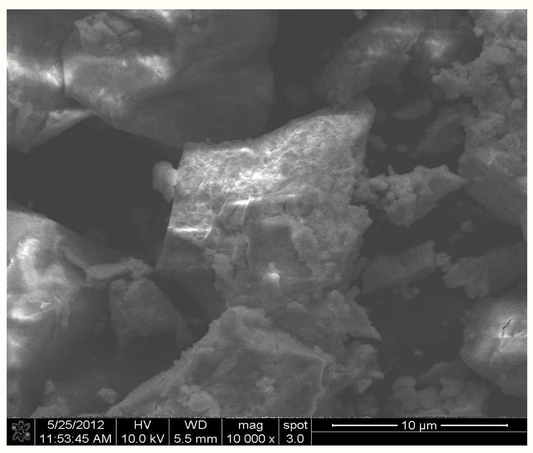


Figure 3. SEM image of the hydroxide precursor(fig 1.) before heat treatment.

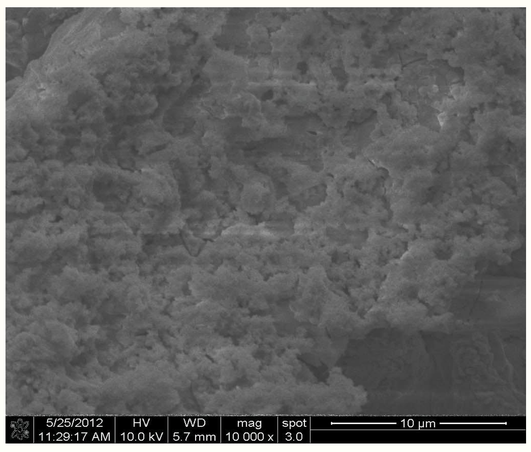


Figure 4. SEM image of the thin film of perovskite(fig 2.) after heat treatment 900 ℃

➢EDS

Ignoring the signal of copper because the precursor powder was not found .It was caused by substrate.. As we see the table 4. Ratio of barium, zirconium and yttrium is 2:1:3 rather than 5:1:1 we want .

Table 4. spectrum of acquisition of thin film of perovskite on copper substrate in solution 3.0

Spectrum：Acquisition

Element	Series	unn. C [wt.%]	norm. C [wt.%]	Atom. C [at.%]	Error (1 Sigma) [wt.%]
Yttrium	L-series	15.03	28.50	14.75	0.76
Oxygen	K-series	11.52	21.84	62.83	2.50
Barium	L-series	15.63	29.64	9.93	0.99
Zirconium	L-series	4.80	9.10	4.59	0.33
Copper	L-series	5.75	10.91	7.90	1.57

Conclusion

BCZY perovskite thin film was more uniform in copper substrate with sand blasting under current density 2.5 mA/cm² in solution pH3 for 1 hour . But the barium and zirconium are more difficult coating seen by EDS analysis. That is the problem we need to overcome in the future.