ZnO Materials as Effective Anodes for the Photoelectrochemical Regeneration of Enzymatically Active NAD+

1. Introduction

vs.

2. Experimental Section

2.1 Materials

Candida boidinii

2.2 Synthesis of ZnO nanowires (ZnOW)

2.3 Synthesis of porous ZnO (ZnOP)-based films

a PHDVXUHGDWHDFK

2.7 Regeneration of NAD^+

vs.

$$NADH \rightarrow NAD^+ + H^+ + 2\,e^-$$

$$Formate + NAD^+ \overset{FDH}{\longleftrightarrow} CO_2 + NADH + H^+$$

3. Results and discussion

3.1 Morphological and structural characterization of ZnO nanostructures and films

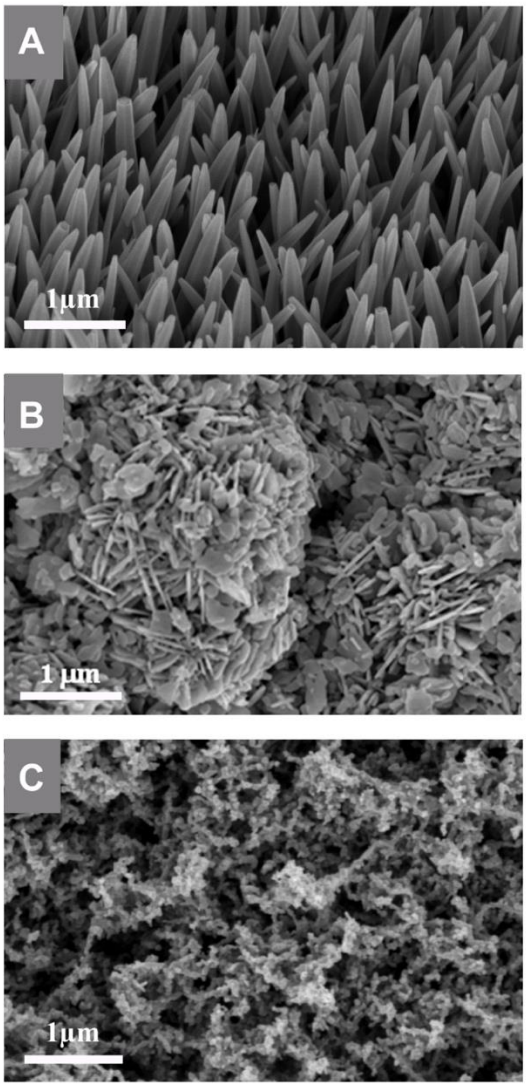

Figure 1.

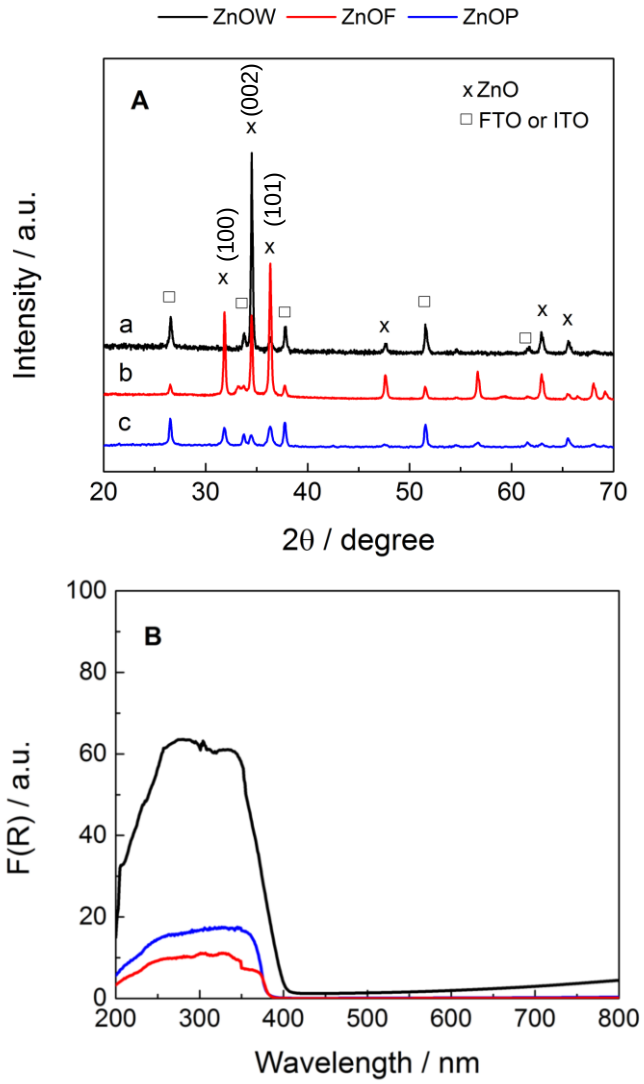
ZnOW
ZnOF
ZnOP
A
x ZnO
□ FTO or ITO
(002)
(100)
(101)
a
b
c
Intensity / a.u.
2θ / degree
B
F(R) / a.u.
Wavelength / nm

Figure 2.

Table 1.

			7KLFNQHVV P	

3.2. Electrochemical oxidation of NADH

vs.

vs.

vs.

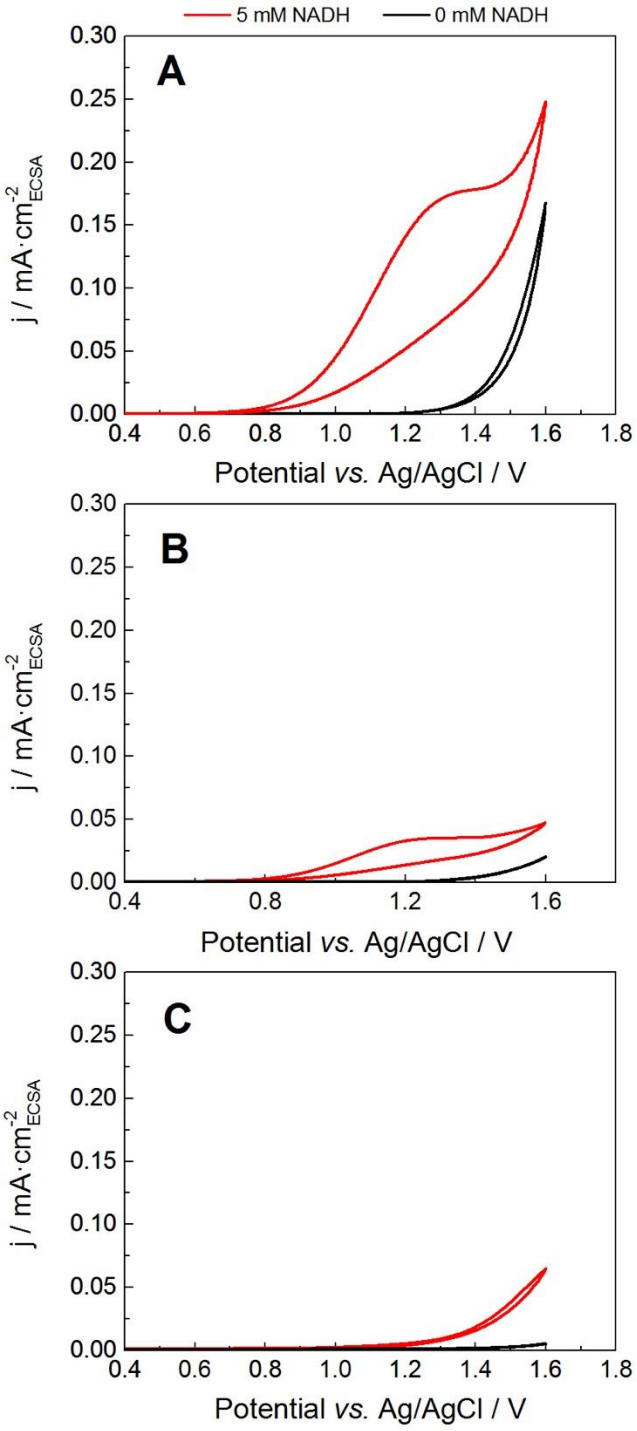
5 mM NADH
0 mM NADH
A
B
C
j / mA·cm-2ECSA
Potential vs. Ag/AgCl / V
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8

Figure 3.

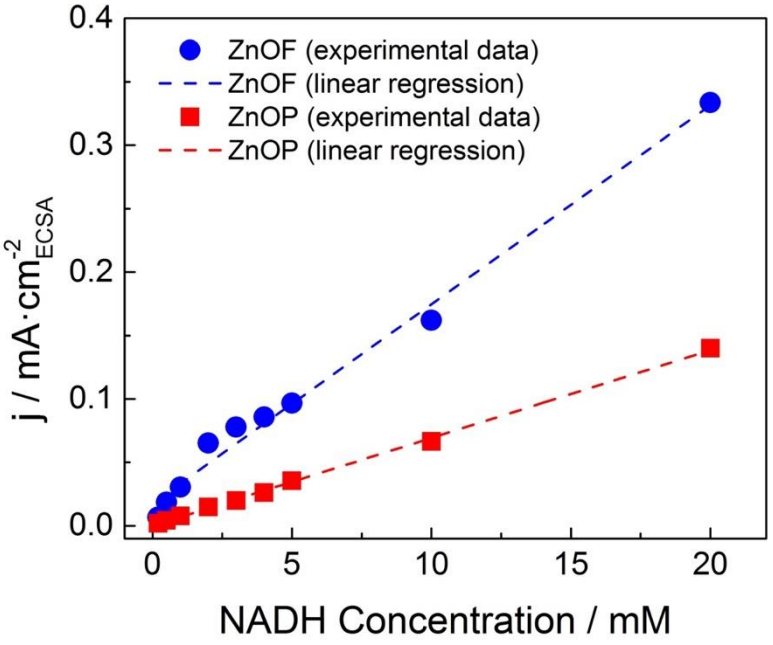

Figure 4.

3.3 Effect of the illumination

vs.

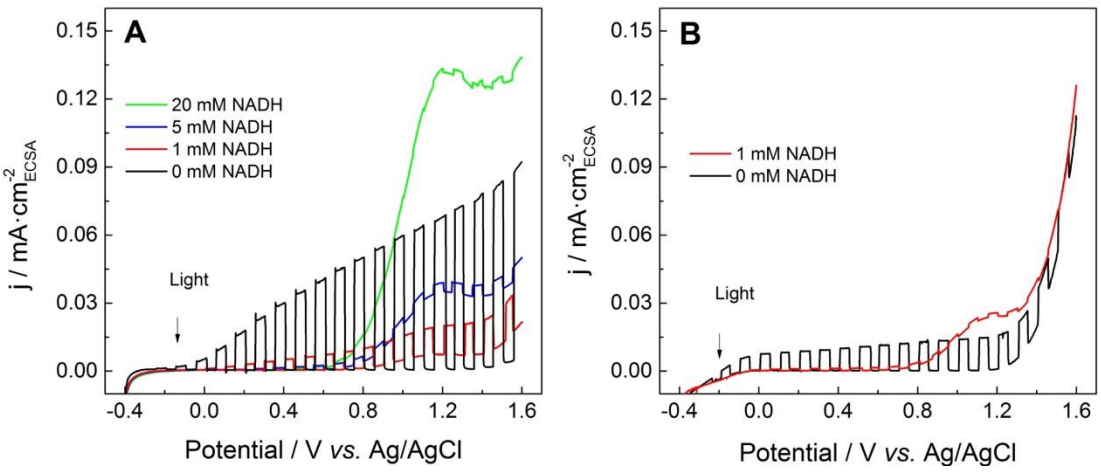
A
B
20 mM NADH
5 mM NADH
1 mM NADH
0 mM NADH
Light
j / mA·cm-2ECSA
Potential / V vs. Ag/AgCl
0.15
0.12
0.09
0.06
0.03
0.00
-0.4
0.0
0.4
0.8
1.2
1.6

Figure 5.

Table 2. 6FKHUUHU ¶ V

3.4 Photoelectrochemical oxidation of NADH

vs.

R[LGDWLRQUDWHRI PROPLQ

YHUVXV PROPLQ

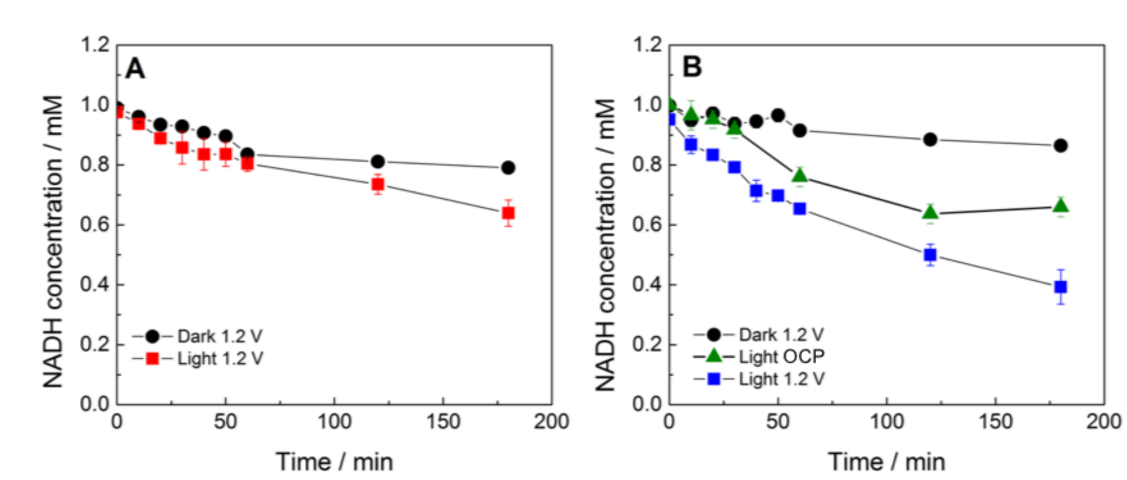

Figure 6.

vs.

vs.

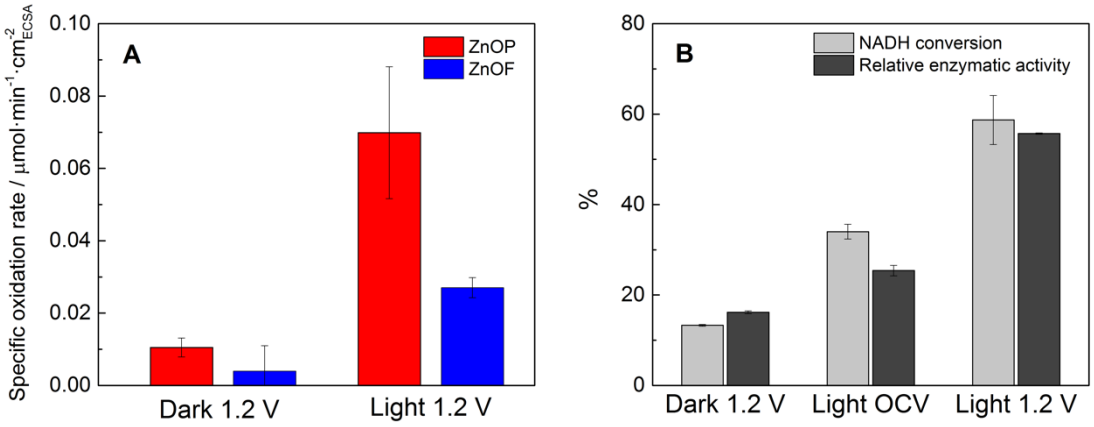
A
ZnOP
ZnOF
Specific oxidation rate / μmol·min-1·cm-2ECSA
0.10
0.08
0.06
0.04
0.02
0.00
Dark 1.2 V
Light 1.2 V
B
NADH conversion
Relative enzymatic activity
%
80
60
40
20
0
Dark 1.2 V
Light OCV
Light 1.2 V

Figure 7. *vs.*

3.5 Enzymatic activity of regenerated NAD

vs. *vs*.

vs.

4. Conclusion

Supporting Information ECSA calculation; Optical characterization of the electrodes.

Corresponding Author

Present Addresses

Author Contributions

Funding Sources

S. cerevisiae *J. Appl.*

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-

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Anal. Chim. Acta. **2003** *476* í

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