

XANES Investigation of the Effects of TiO₂ Photoelectrode Preparation Methods

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In Schmidt.etc. al reserch [1], the intensity D3 and E3 in L3 eg peak of Ti L-edge that can identified the crystal structure, the anatase showed the higher intensity of D3 characteristic peak, the rutile showed the higher intensity of E3 characteristic peak. The XANES figure showed the strong intensity in left side of L3 eg L-edge, it was anatase crystallization. According to the L3 t2g peak of XANES that can analysis the oxidation state and valence change of Ti, the defect could affect the oxidation state and valence change.

TiO₂ photoelectrodes were prepared using obtained TiO₂ nanoparticles using the optimal hydrothermal condition. TiO₂ photoelectrodes were sintered under different environments of air, O₂, and N₂. For surface plasma treatments, O₂, H₂, N₂, and CH₄ + N₂ were used. It was found that the sintering gases affect the oxidation state of Ti, dye adsorption, and the cell efficiency. For different sintering gases, higher cell efficiency was obtained when with O₂ was used as the sintering gas. This is ascribed to the increased Ti oxide state and improved dye adsorption in Fig. 1 and table 1, it showed the oxide vacancy decreases in oxygen.

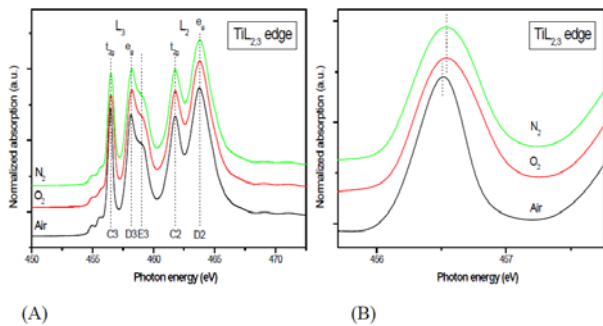


Fig. 1: XANES figure of different sintering gas for Ti.
(B) Characteric peak.

Table 1: Characteric peak position.

Sample	C3(eV)	D3(eV)	E3(eV)	C2(eV)	D2(eV)	Δ_2 (eV)
Air	456.50	458.14	459.24	461.79	463.78	1.99
O	456.52	458.23	459.28	461.79	463.78	1.99
N	456.52	458.23	459.28	461.79	463.78	1.99

For plasma treatment, O₂ plasma treatment was found to have the same effect as oxygen sintering in Fig. 2. And characteric peak position was shifted to lower energy state after O₂ plasma treatment in table 1, it also showed the increasing oxidation state of Ti.

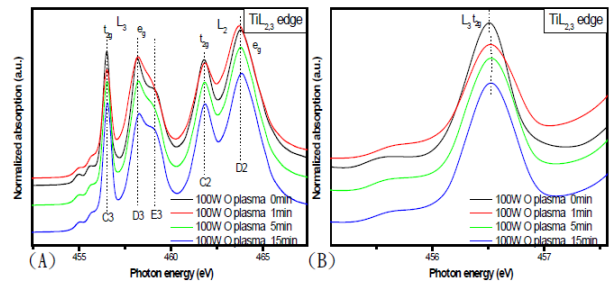


Fig. 2: XANES figure of O₂ plasma treatment for different time. (B) Characteric peak.

Table 2: Characteric peak position of different time for O₂ plasma treatment.

Treating Time(min)	C3(eV)	D3(eV)	E3(eV)	C2(eV)	D2(eV)	Δ_2 (eV)
0	456.50	458.14	459.24	461.79	463.78	1.99
1	456.52	458.23	459.22	461.87	463.72	1.85
5	456.53	458.24	459.22	461.85	463.80	1.95
15	456.52	458.27	459.20	461.86	463.85	1.99

Reference

- [1] D. A. Schmidt, S. A. Chambers, M. A. Olmstead, and WA, *Fundamental Science Division*