

# ガラス基板上へのパターン化に成功した酸化亜鉛(ZnO)薄膜蛍光体 ～スパッタリングによる薄膜成長、ウェットエッチング、還元処理を経て～

## Precisely patterned ZnO thin film phosphor fabricated directly on glass substrate

—after thin film fabrication with sputtering, wet etching, annealing—

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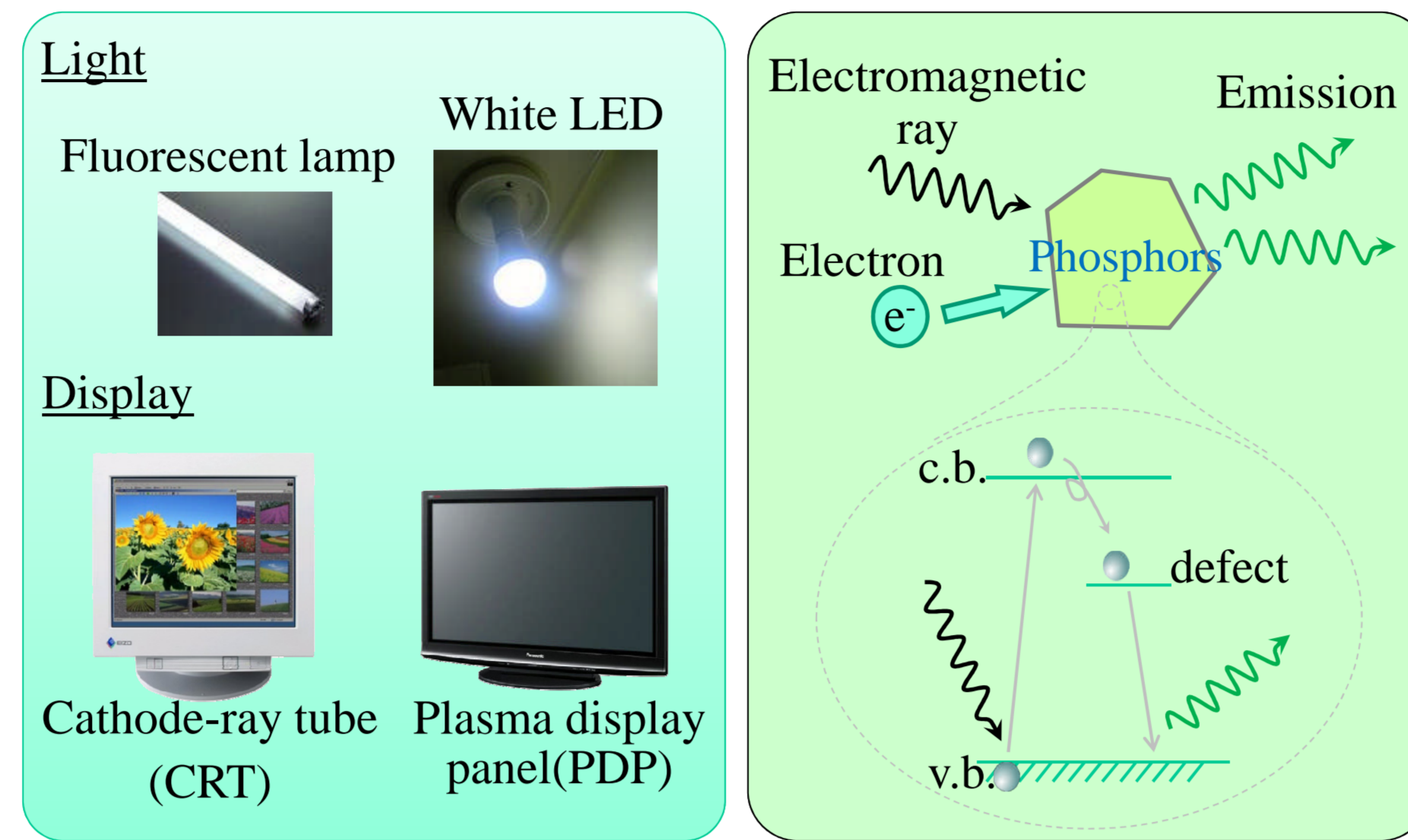
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### Abstract

- The development of new and high efficient phosphor has been an important technology for the display industry.
- we developed a novel technique for fabricating ZnO thin film phosphor on the glass substrate directly at the low temperature.
- This fabricated ZnO thin film phosphor has the promising features including higher coherency, uniformity, flatness regarding to the disadvantage of the power phosphor.
- ZnO thin film phosphor, showing high luminance of blue-green, was easily and precisely patterned on large area (100 mm in diameter) by wet etching method.

### Application & emission principle of ZnO phosphor



### Powder & Thin film phosphor

**Advantage:**  
Long life-time;  
High luminescence;  
Various shape.

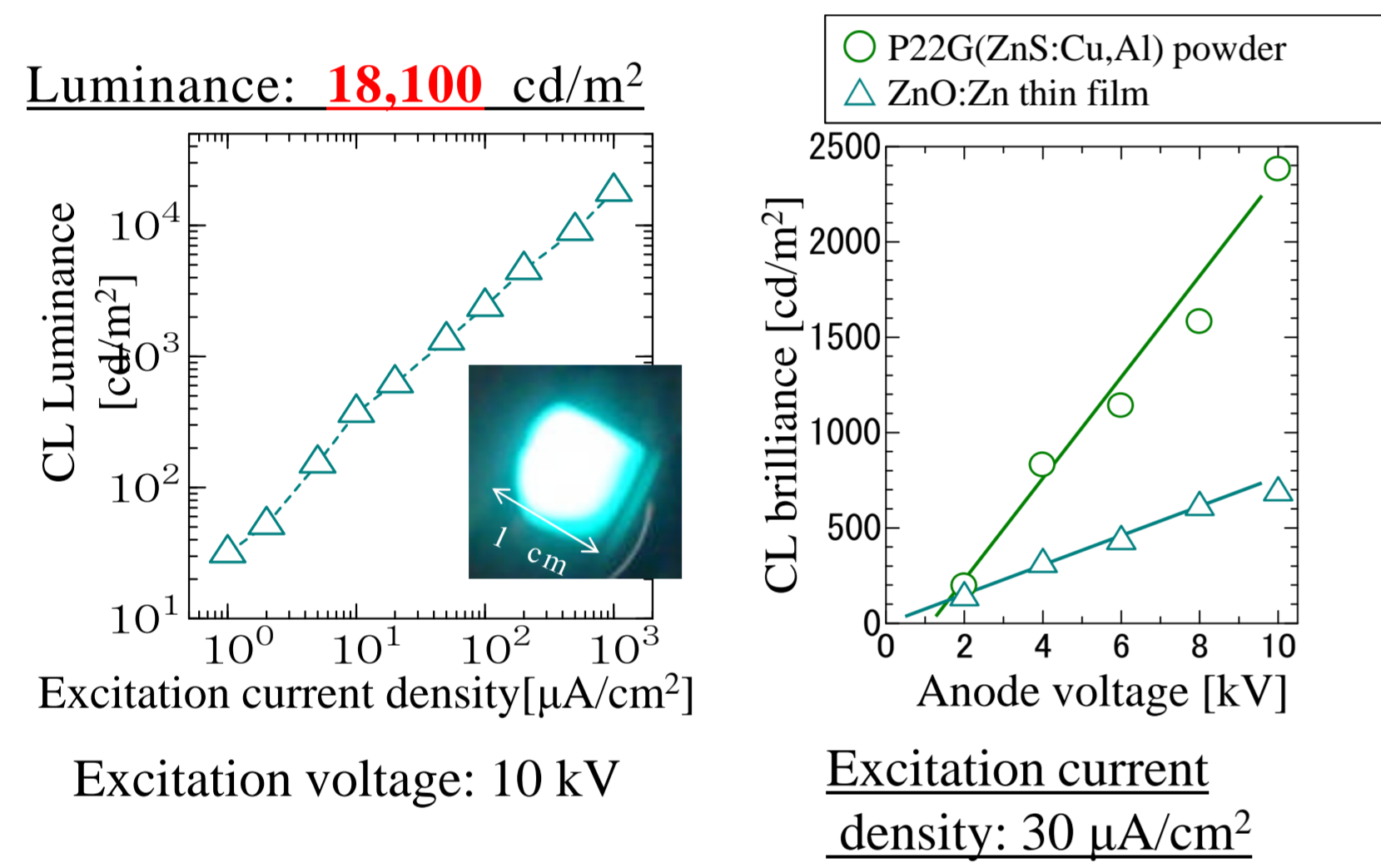
**Drawback:**  
High temperature treatment;  
Un-uniformity.

**Advantage:**  
High coherency;  
Uniformity;  
Low temperature treatment;  
Low cost.

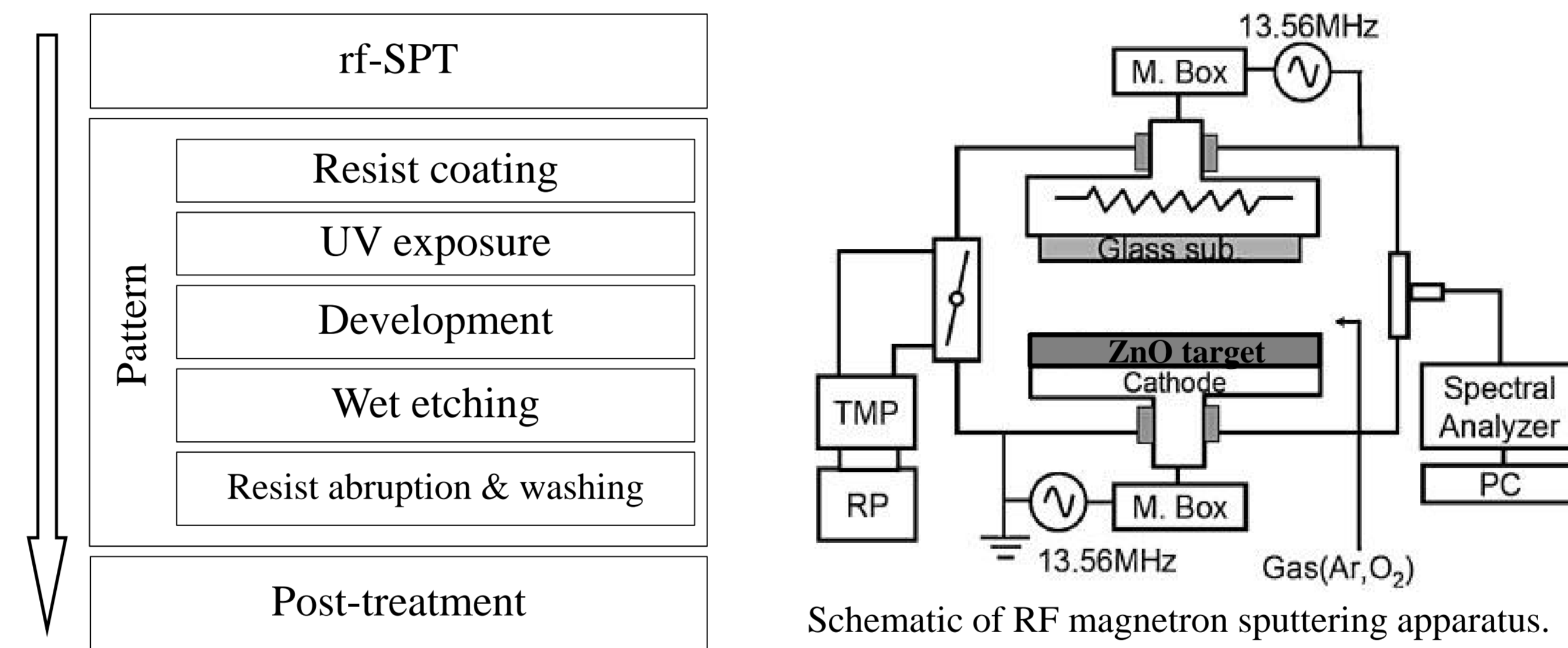
**Drawback:**  
Weak emission intensity.

Thin film phosphor have attracted increasing attentions. Intense luminescence was obtained from ZnO thin film annealed in reducing gas at a low temperature of 450° C in 2009.

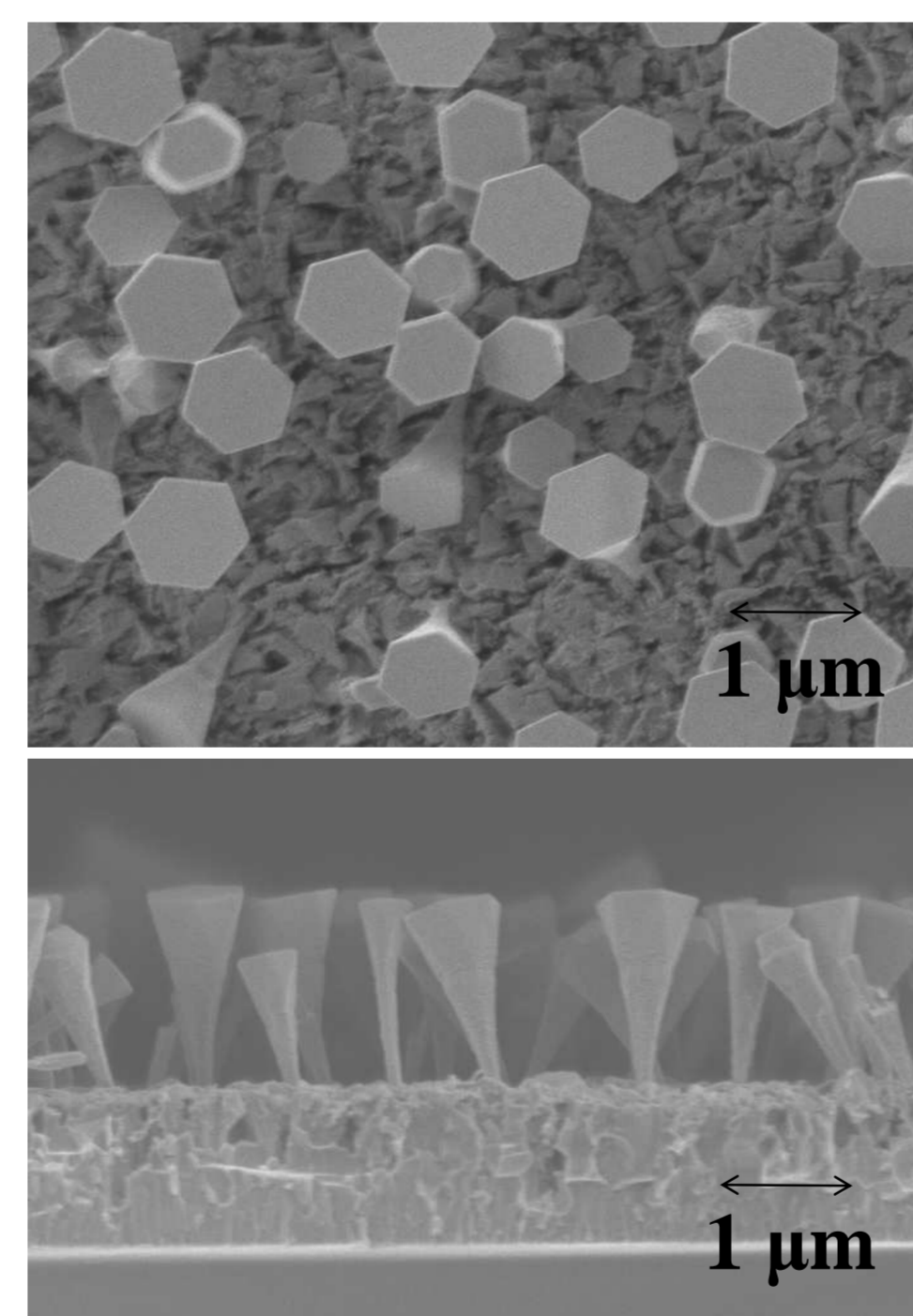
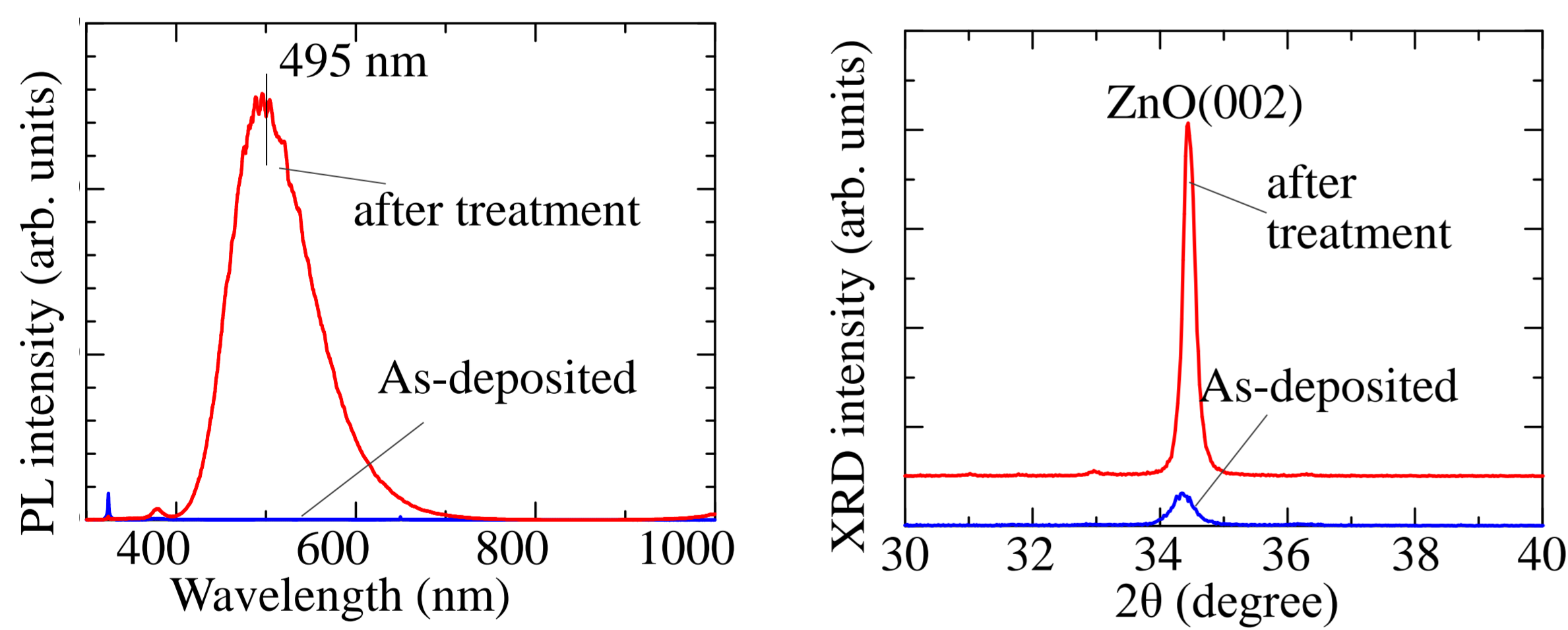
### History of ZnO thin film phosphor in my lab



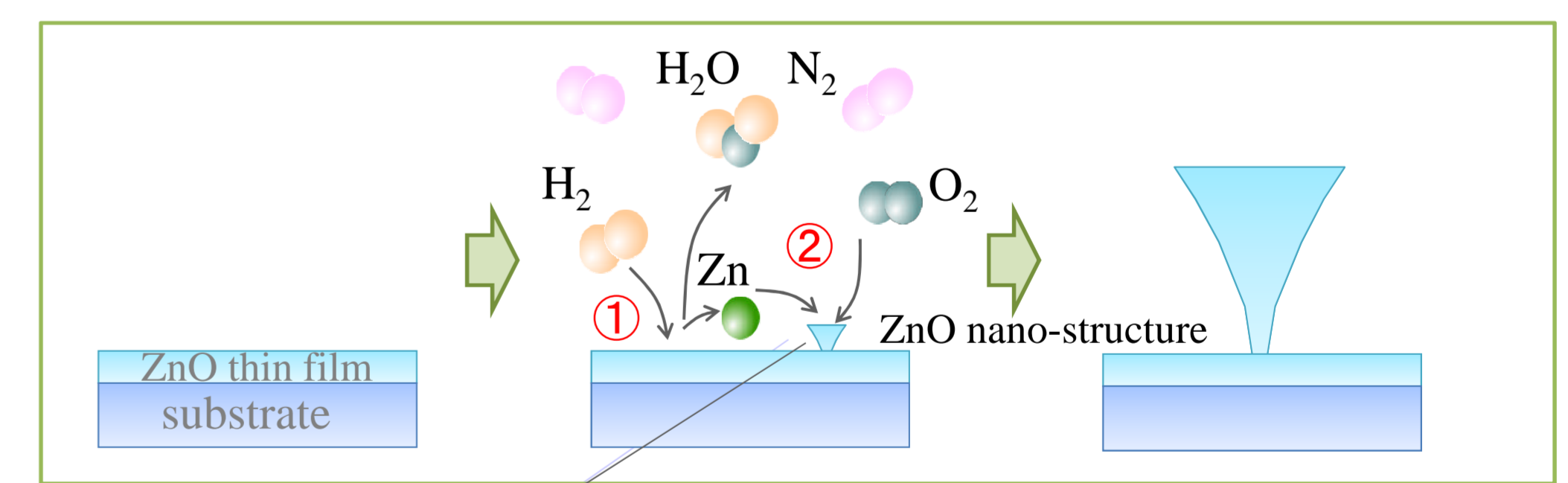
### How to pattern ZnO thin film phosphor?



### Properties of ZnO thin film phosphor



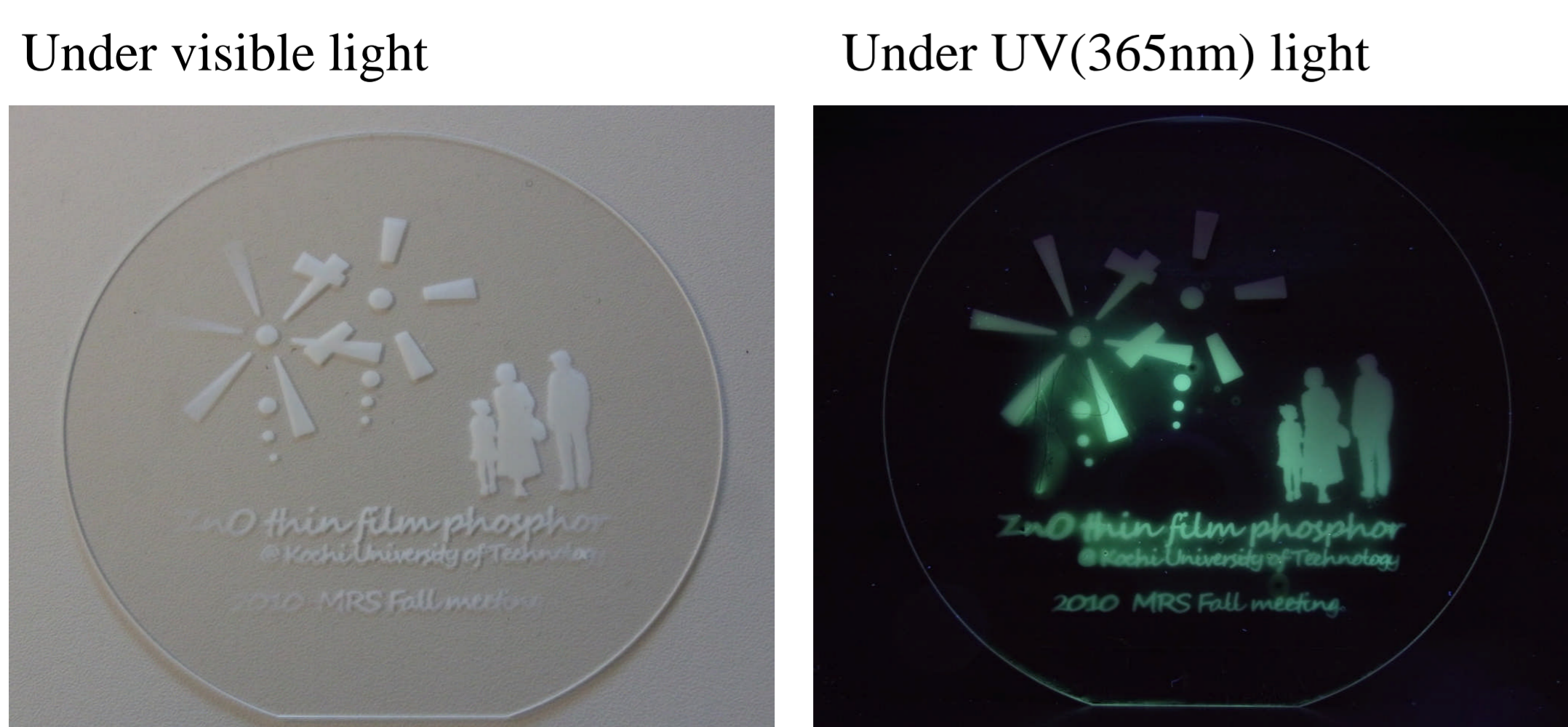
### Growth mechanism of ZnO nanostructures



The formation of fluted hexagonal cone:  
Reaction: (Melting point of Zn: 420 °C)

- ① ZnO + H<sub>2</sub> -> Zn + H<sub>2</sub>O (etching)
- ② Zn + O -> ZnO (re-growth)

### Precisely patterned ZnO thin film phosphor



Precisely patterned ZnO thin film phosphor was achieved successfully after low temperature post-treatment.

Ref 2: C. Li et al.: patent application, 2011-7387 (2011.1.17)

### Conclusions

- ZnO thin film was deposited on quartz glass by RF magnetron sputtering. Patterned ZnO thin film phosphor is firstly achieved in the world. The accuracy of patterned thin film can be minimum as the size of mask. The place of luminescence can be easily designed.
- Patterned ZnO thin film phosphor with intense luminance of blue-green was achieved from a large quartz glass substrate by wet etching method.
- The present results show the patterned ZnO thin films will be a promising candidate to be used in the lighting industry.

