ECCS 2025 Conference
The 3rd International Electronic Conference on Catalysis Sciences
23–25 April 2025 | Online
MDPI
sciforum-112643

Development of photocatalytic reduction method of Cr(Ⅵ) with modified g-C_3N_4

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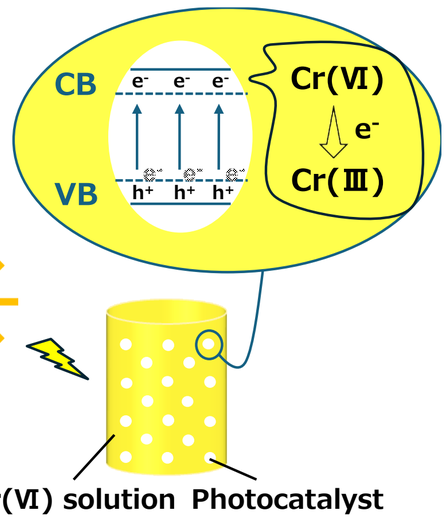
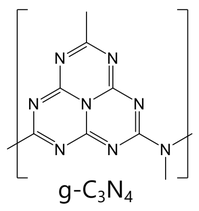
INTRODUCTION & AIM

Heavy metal pollution

Cr(Ⅵ) is highly toxic and has adverse effects on ecosystems. It is preferable to reduce it to **Cr(Ⅲ)** which is less toxic.

In our research, we use graphitic carbon nitride (**g-C_3N_4**) as photocatalyst.





【GOOD】
- High thermal and chemical stability
- Metal free

【BAD】
- The high recombination rates of electrons(e^-) and holes(h^+)

Previous : g-C_3N_4 has low reactivity in the visible light range.
This research : We modify g-C_3N_4 to introduce electron capture groups.

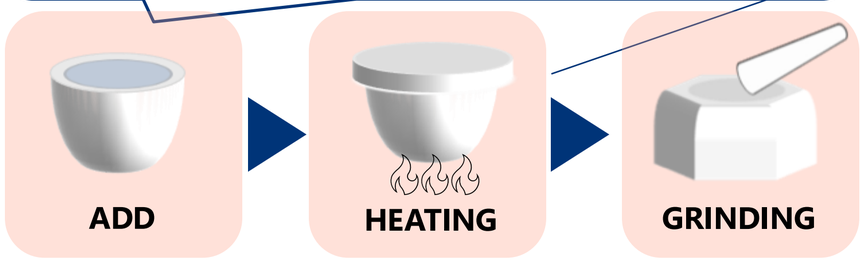
【AIM】 Practical application in the visible light range

METHOD

Method of catalyst preparation

Urea (20 g) + 1,3,5-Trihydroxybenzene(T) (① 0, ② 2.5, ③ 5.0, ④ 7.5, ⑤ 10.0 mg) + H_2O Water (10 mL)

HEATING CONDITION
2 ℃/min, 500 ℃, 2 h



Color of photocatalysts
①T0.0 (g-C_3N_4) ②T2.5 ③T5.0 ④T7.5 ⑤T10.0

Method of reduction experiment

Photocatalyst, 15 mg
Water, 50 mL
Cr(Ⅵ), 30 ppm
EDTA, 300 ppm

Blue light : 450 nm

Analysis method
Colormetric method with 1,5-diphenylcarbazide using UV-VIS spectrophotometer (wavelength : 540 nm)

Fig.1. Equipment diagram.

RESULTS & DISCUSSION

Results of experiment

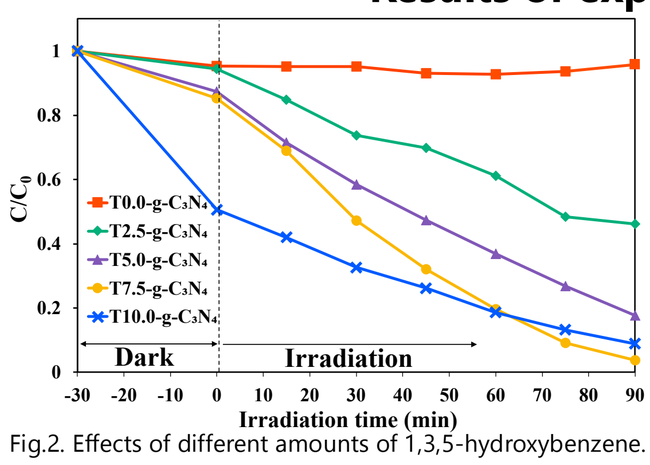


Fig.2. Effects of different amounts of 1,3,5-hydroxybenzene.

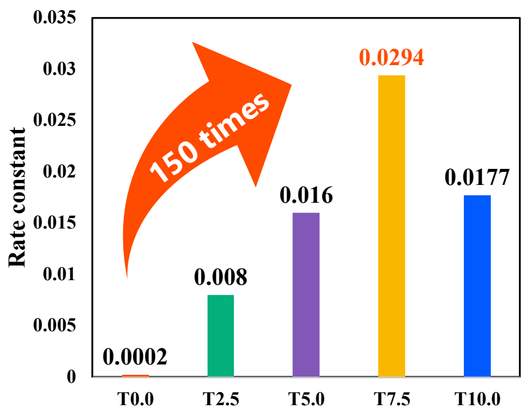


Fig.3. Rate constants for reduction experiments.

RESULTS & DISCUSSION

Optimization of conditions

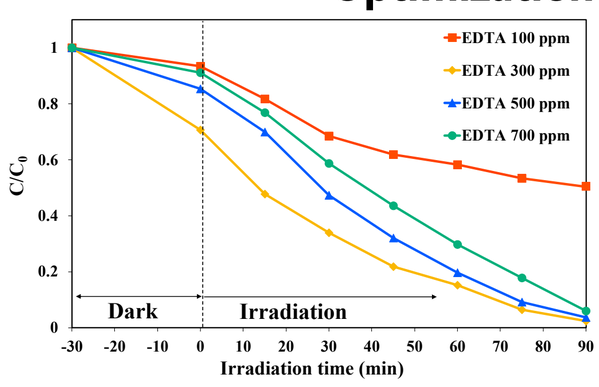


Fig.4. Effect of EDTA on the reduction of Cr(Ⅵ) with T7.5-g-C_3N_4.

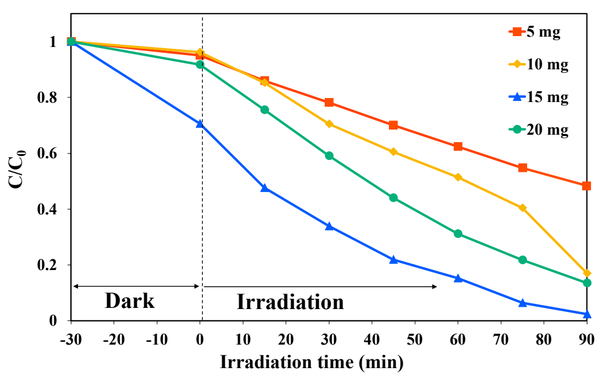


Fig.5. Effect of T7.5-g-C_3N_4 amount on the reduction of Cr(Ⅵ).

EDTA : **300 ppm**, Catalyst amount : **15 mg** was optimal conditions.

Results of characterization

Structure

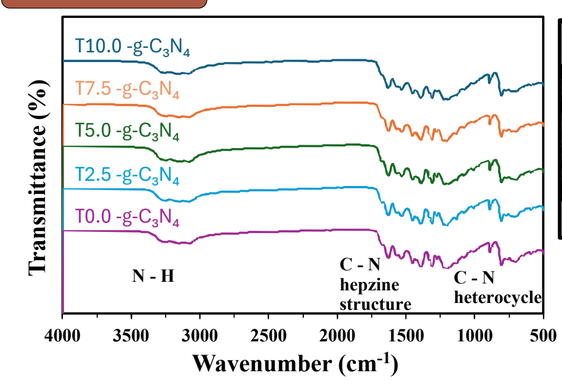


Fig.6. The FT-IR patterns of each photocatalysts.

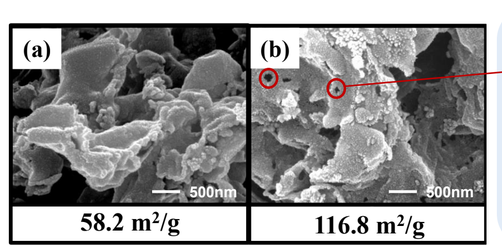


Fig.7. SEM images and BET surface areas of (a) T0.0-g-C_3N_4(g-C_3N_4), (b) T7.5-g-C_3N_4.

Increase in holes due to structural changes

1,3,5-T changed the structure and increased the surface area **2 times.**

Property

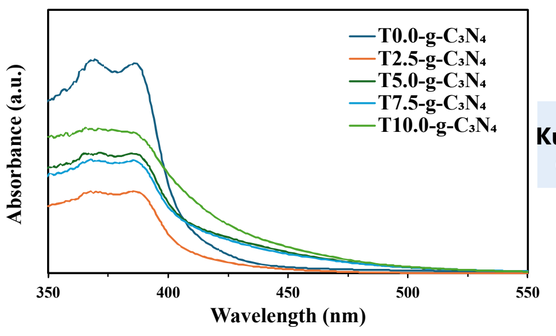


Fig.8. The DRS spectra of each photocatalysts.

Kubelka-Munk Conversion

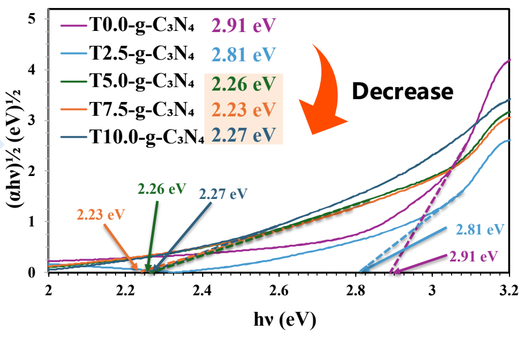
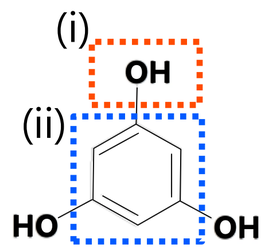


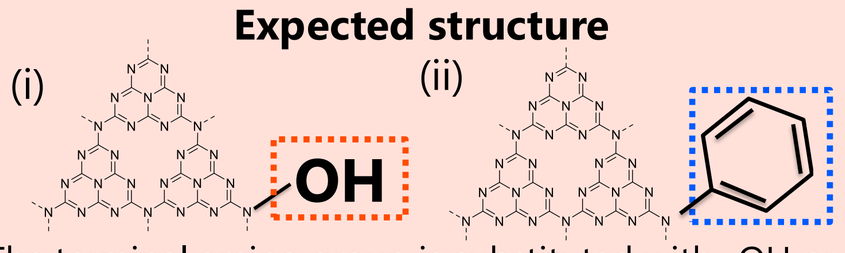
Fig.9. Tauc plots of each photocatalysts.

The absorption edge of the DRS spectrum **expanded** when the amount of T was increased. (T5.0, T7.5, T10.0 –g-C_3N_4)

Discussion



Expected structure



The terminal amino group is substituted with -OH or an aromatic ring. → **Facilitate electron transfer**.

CONCLUSION

- **T7.5-g-C_3N_4** exhibited a rate constant **150 times higher** than that of stand-alone g-C_3N_4(T0.0-g-C_3N_4).
- One of the reasons for the increase in the reduction rate may be the **increase** in the area of **active surfaces**.

FUTURE WORK / REFERENCES

- We do further characterization.
  PL : Movement of excited electrons, XPS : Structure of catalyst
- We will experiment about the active species and the recyclability of the catalyst.