Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.


# Electronic Supplementary Materials (ESI)

# Mg-modified graphitic carbon nitride/converter slag composite as an efficient photocatalyst for sugar conversion

Assadawoot Srikhaow, Chitiphon Chuaicham, Jirawat Trakulmututa, Kaiqian Shu and Keiko Sasaki*

Department of Earth Resources Engineering, Kyushu University, Fukuoka, 819-0395, Japan. Email: keikos@mine.kyushu-u.ac.jp

## Chemicals

Dicyandiamide (DA, 99%) were supplied by KISHIDA Chemical Co., Ltd, Japan. D-glucose (anhydrous, 99%), Ethanol (99.5%), sodium hydroxide (NaOH, 97%), magnesium chloride hexahydrate ($MgCl_2$•$6H_2O$, 97%), sulfuric acid (95%), ethylenediaminetetraacetic acid disodium salt (EDTA-2Na, 99.5%), para-benzoquinone (BQ, 98%), tryptophan (TRP, 99%), and isopropyl alcohol (IPA, 99.7%) were purchased from FUJIFILM Wako Pure Chemical Corp., Japan.

## Photocatalytic experiments

The glucose conversion and the lactic acid yield were calculated using the following equations[1]:

$$Glucose\ conversion\ (\%) = (1 - \left(\frac{Molar\ of\ glucose\ after\ the\ reaction}{Molar\ of\ initail\ glucose}\right)) \times 100 \quad (1)$$

$$Lactic\ acid\ yield\ (\%) = \frac{3 \times Molar\ of\ lactic\ acid\ \ in\ the\ reaction}{6 \times Molar\ of\ initial\ glucose} \times 100 \quad (2)$$

**Table S1. Chemical compositions of converter slag (CS) by XRF analysis.**

| Composition | (%) |
|---|---|
| CaO | 45.08 |
| $Fe_2O_3$ | 25.52 |
| $SiO_2$ | 12.62 |
| $Al_2O_3$ | 7.55 |
| MgO | 4.18 |
| $P_2O_5$ | 2.36 |
| MnO | 1.55 |
| $TiO_2$ | 0.36 |
| $SO_3$ | 0.23 |

**Note:** The chemical compositions of CS with concentration lower than 0.05% are not included.

**Table S2. Full width at half maximum (FWHM) calculation of all CN-based samples from XRD results.**

| Sample | FWHM from 002 plan of g-$C_3N_4$ |
|---|---|
| Pure CN | 1.224° |
| CN/CS | 1.390° |
| 2.3Mg-CN/CS | 1.454° |
| 4.7Mg-CN/CS | 1.555° |
| 7.1Mg-CN/CS | 1.678° |

**Table S3. Surface area ($S_{BET}$), pore volume and average pore diameter of all as-prepared samples.**

| Sample | $S_{BET}$ ($m^2g^{-1}$) | Pore volume ($cm^3g^{-1}$) | Average pore diameter (nm) |
|---|---|---|---|
| CS | 5 | 0.0026 | 22.14 |
| CN | 10 | 0.0784 | 33.32 |
| 4.6Mg-CN | 11 | 0.0897 | 34.17 |
| CN/CS | 16 | 0.1195 | 29.53 |
| 2.3Mg-CN/CS | 17 | 0.1481 | 34.24 |
| 4.7Mg-CN/CS | 21 | 0.2130 | 41.39 |
| 7.1Mg-CN/CS | 25 | 0.2510 | 40.16 |

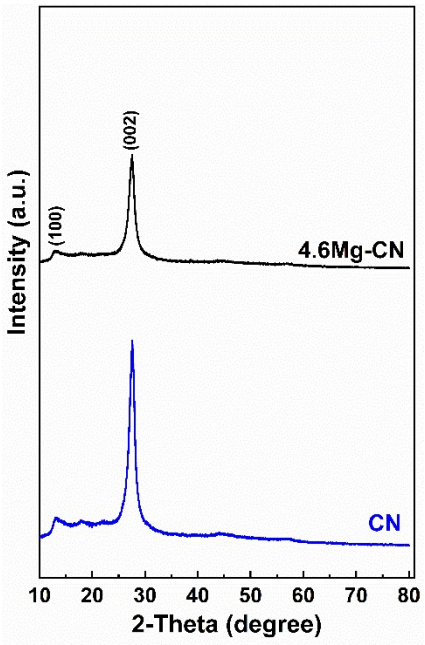


**Fig. S1** XRD diffraction patterns pure CN and 4.6Mg-CN.

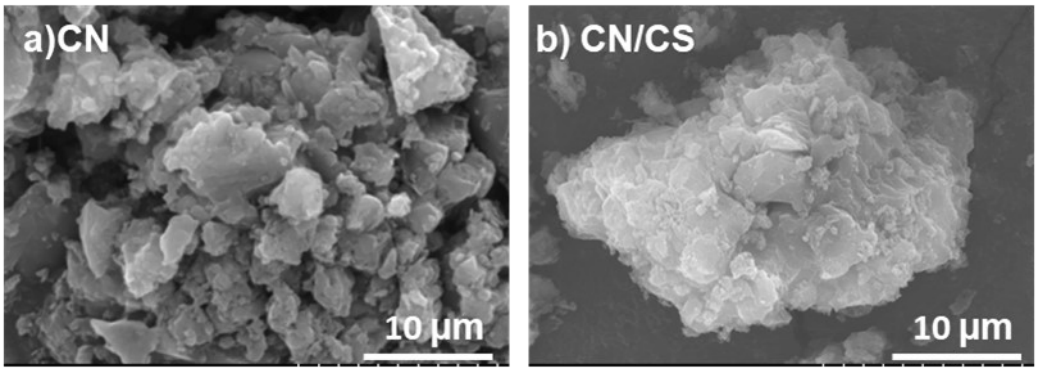


**Fig. S2** SEM images of a) pure CN and (b) CN/CS.

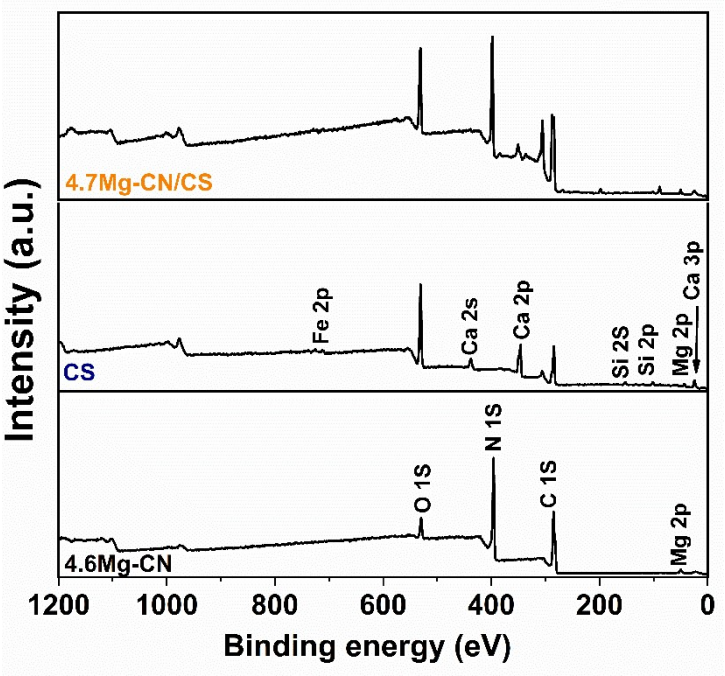


**Fig. S3** XPS survey spectra of 4.6Mg-CN, pure CS and 4.7Mg-CN/CS.

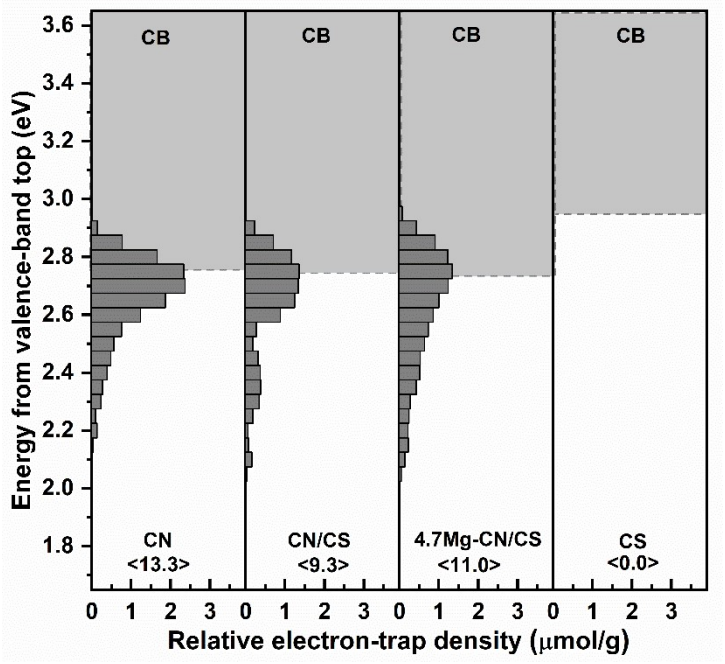


**Fig. S4** the energy-resolved distribution of electron traps (ERDT) patterns of CN, CN/CS, 4.7Mg-CN/CS and CS samples.

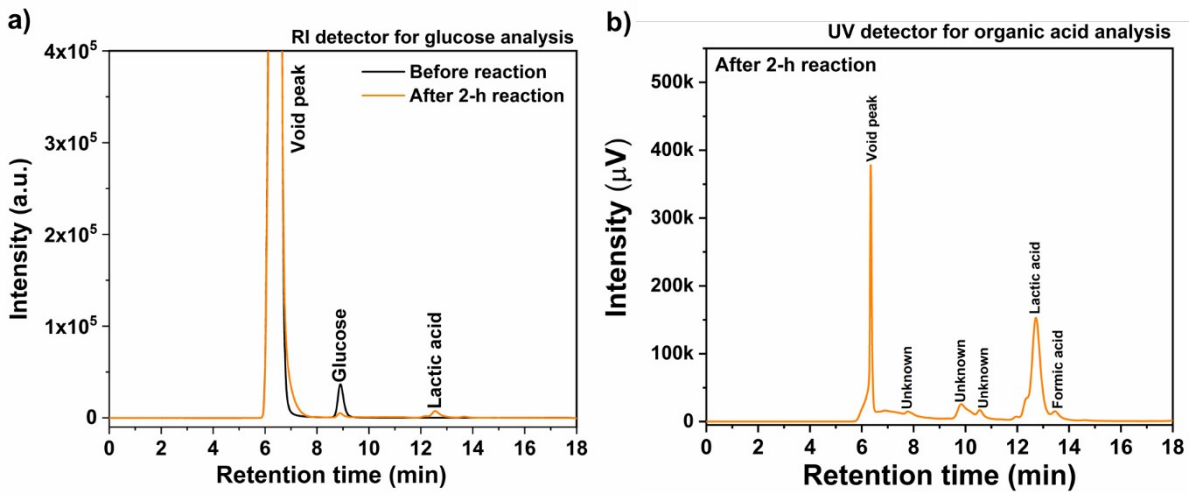


**Fig. S5** HPLC chromatograms of glucose solution after photocatalytic production of lactic acid by 4Mg-CN/CS under visible-light irradiation for 2 h; (a) glucose and (b) lactic acid analysis.

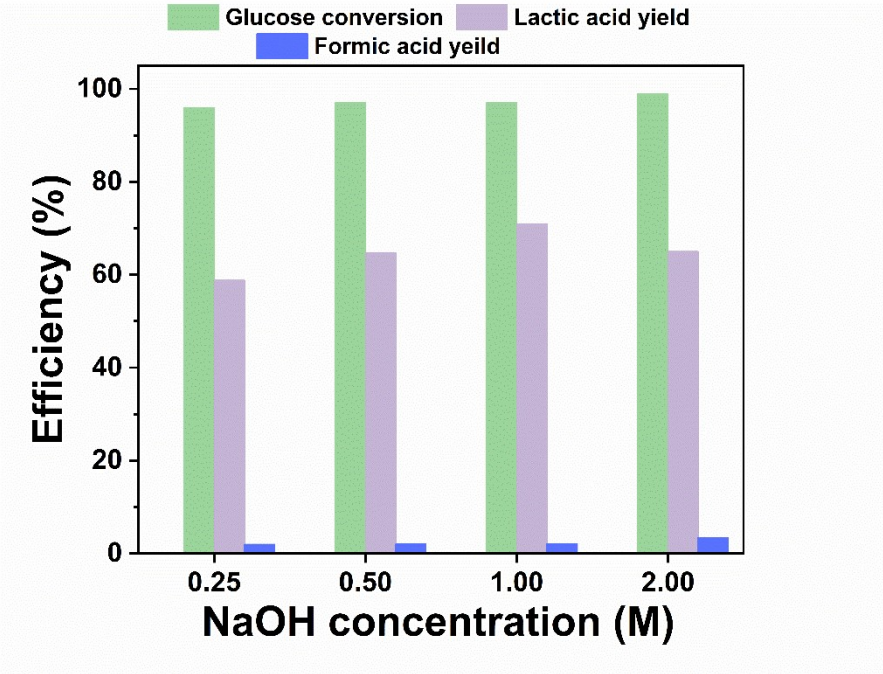


**Fig. S6** effect of NaOH concentration on the photocatalytic conversion of glucose by the 4.7Mg-CN/CS composite under the visible-light irradiation at 50 °C after 120 min.

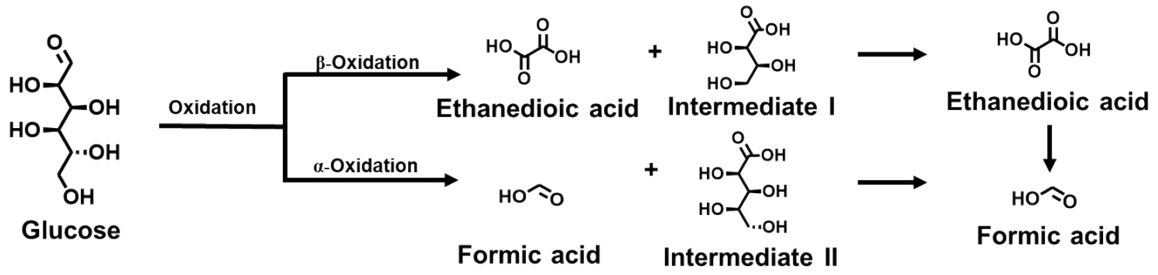


**Fig. S7** Possible side reaction pathways of glucose conversion through α and β oxidation yielding formic acid as a by-product.

## Reference

1. A. Onda, T. Ochi, K. Kajiyoshi and K. Yanagisawa, *Applied Catalysis A: General*, 2008, **343**, 49-54.