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Photoinduced Nitric Oxide Release and Thermal Conversion Boosted by Electronic Modulation in N-Doped Carbon Nanodot Conjugates

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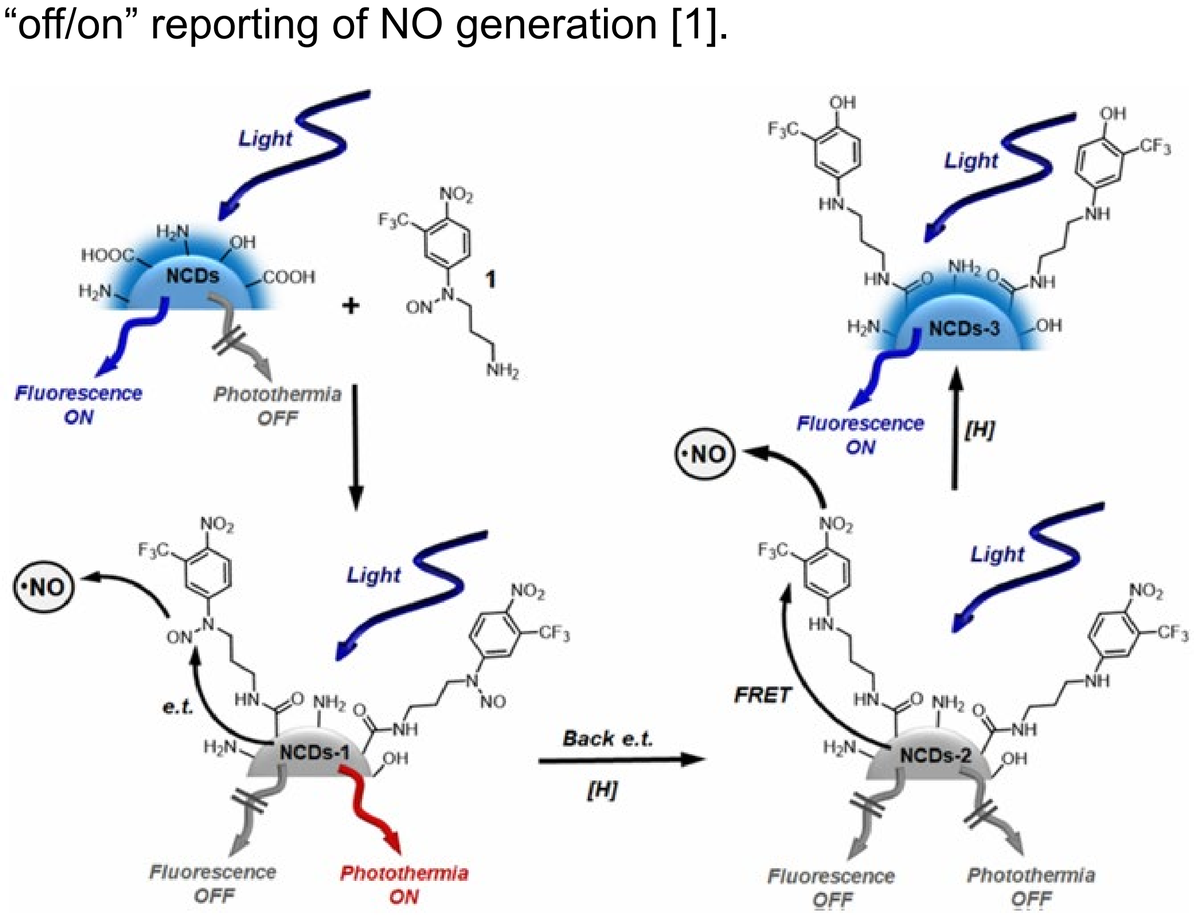
INTRODUCTION & AIM

Carbon Dots (CDs) are biocompatible carbon nanoparticles with tunable optical properties, applied in sensing, imaging, and phototherapy. Nitric oxide (NO), a key biological regulator with anticancer potential, requires controlled release, making NO photodonors (NOPDs) highly attractive. Combining CDs and NOPDs enables light-triggered release and fluorescent monitoring. In this work, the new nanoconjugate **NCDs-1**, obtained by linking N-doped CDs to NOPD1, shows enhanced NO photorelease, photothermal conversion, and fluorescence "off/on" reporting of NO generation [1].



Scheme 1. Sketch of the nanoconjugate **NCDs-1** and of its stepwise photoconversion to NCDs-2 and then to NCDs-3 under visible light.

RESULTS & DISCUSSION

Luminescent, water-soluble, nitrogen-doped CDs (**NCDs**) were synthesized via a hydrothermal route from citric acid and urea [2]. The **NCDs-1** nanoconjugate exhibited a distinct absorption band in the blue region (Fig. 1A), absent in the simple physical mixture of the reagents, evidencing strong electronic interactions between **NCDs** and **1**, which persist even in the excited states (Fig. 1B). Under blue light irradiation, **NCDs-1** showed photolysis behavior similar to free **1** (Fig.1C) but with markedly enhanced photoreactivity (Fig.1D). Upon prolonged irradiation, a second NO molecule was released (Fig. 2A) accompanied by a fluorescence decrease (Fig. 2B). Moreover, **NCDs-1** displayed strongly enhanced photothermal properties compared to bare **NCDs** (Fig. 2C).

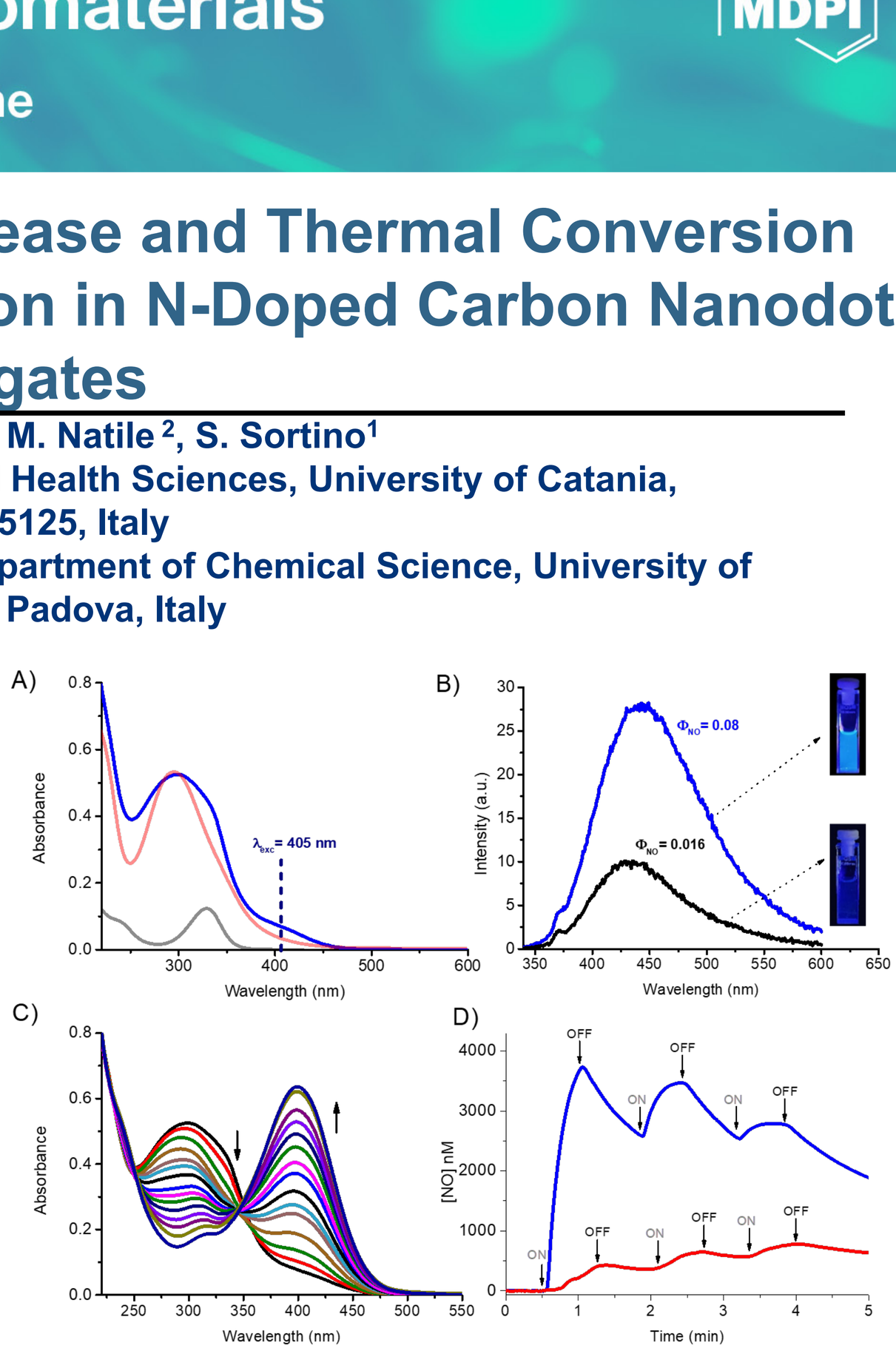
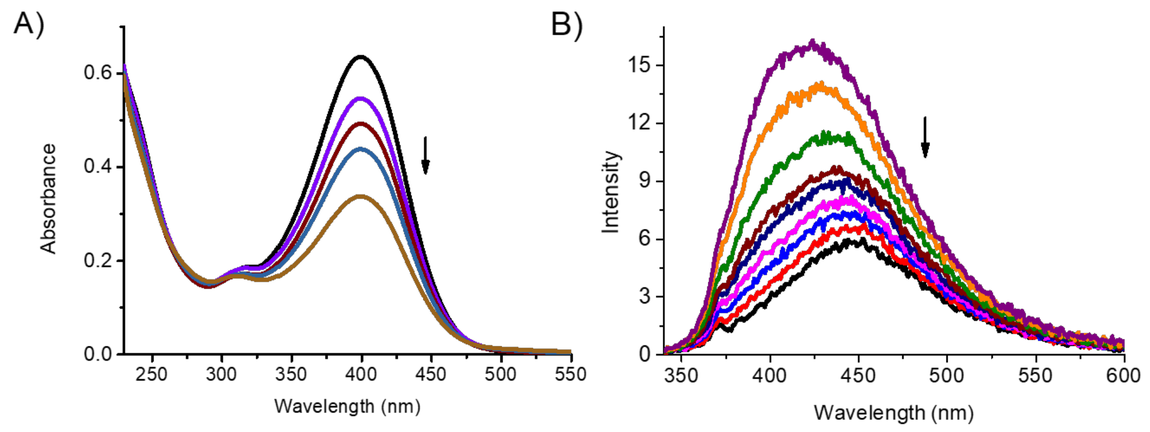


Fig. 1 (A) Absorption and (B) emission spectra (λ_{exc} = 330 nm) of **NCDs-1** (blue), NCDs (black), and 1 (red) in aqueous solution (1% MeOH); inset: sample images under UV light. (C) Absorption changes of NCDs-1 upon irradiation at 405 nm (0–39 min). (D) NO release profiles of **NCDs-1** (blue) and 1 (red) under alternating 405 nm light cycles.



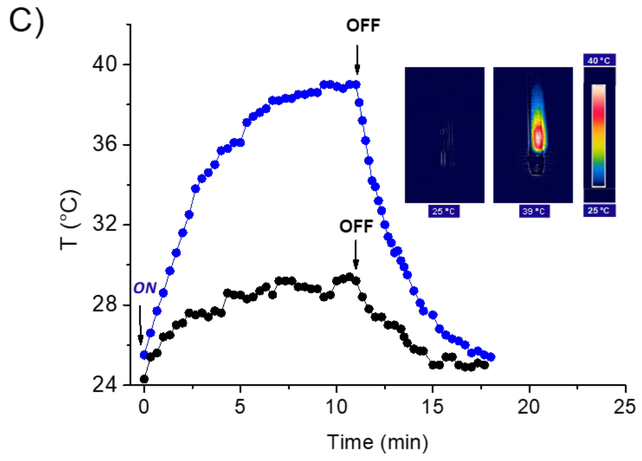


Fig. 2 (A) Absorption and (B) emission spectra (λ_{exc} = 330 nm) of **NCDs-1** in aqueous solution (1% MeOH, 39–180 min). (C) Temperature increase under 405 nm irradiation of **NCDs-1** (blue) compared with bare **NCDs** (black).

REFERENCES

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[2] Qi, H., Qiu, L., Zhang, X., Yi, T., Jing, J., Sami, R., Alanazi, S.F., Alqahtani, Z., Aljabri, M.D., Rahman, M.M. (2023). *RSC advances*, 13(4), 2663-2671.