

Uncovering of the Structure and Reactivity Correlation of CO-Photorelease from 3-Hydroxyflavone-Based Acid-Base Forms

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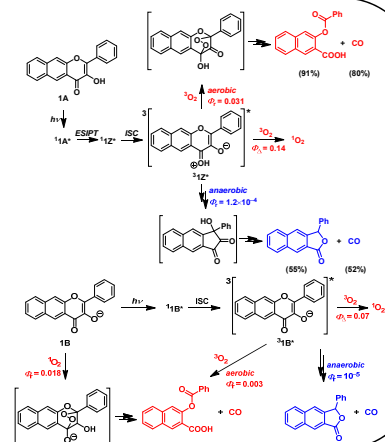
The well-established toxicity of carbon monoxide (CO) appears contradictory with its possible therapeutical function. Indeed, it has recently been discovered that CO is produced endogenously.

Studies of the effects of CO have demonstrated its potential to produce a variety of beneficial health outcomes, including anti-inflammatory, anti-bacterial effects, and antiproliferative effects on cancer.¹ Therefore, CO-releasing molecules (CORMs), biologically compatible agents allowing for a defined administration of CO into living organisms to circumvent its acute toxicity, are of special interest.² A precise spatial and temporal control over the CO release can be achieved via activation of the CORM (photoCORMs) by light.

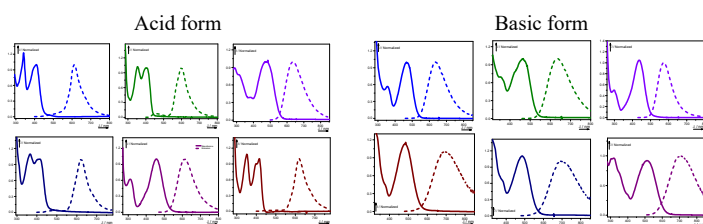
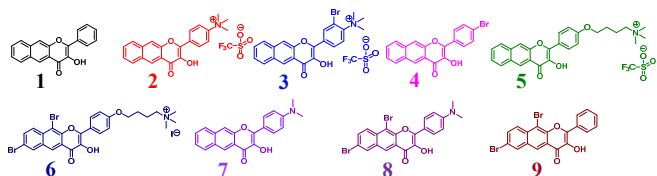
A good photoCORM should be stable under ambient conditions and soluble in aerobic aqueous environments. It should release CO using light at wavelengths that do not have the potential to impart cellular damage and may exhibit fluorescence to enable tracking in the cell.

Understanding the mechanism is a key step for designing new derivatives with improved properties for biological applications, such as water solubility, higher quantum yields and the absorption spectra in the visible light region.

The detailed mechanism of the photochemically induced CO release from 3-hydroxy-2-phenyl-benzo[*g*]chromen-4-one has been studied in our group.³ A deeper understanding is presented in this structure/reactivity study of CO-photorelease reactions from this class of compounds with the aim to design better photoCORMs for biological applications.



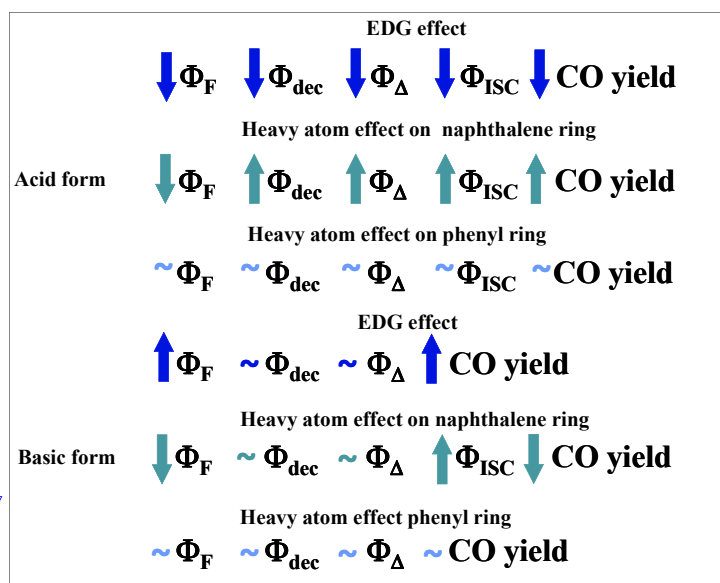
I. Photophysical and Photochemical Properties



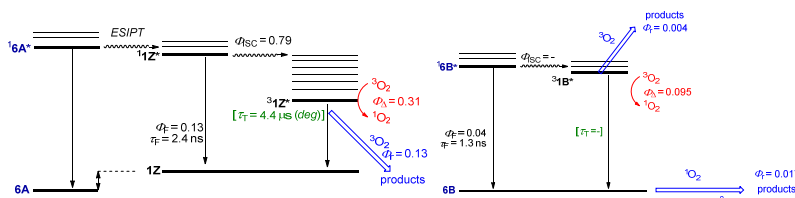
Compd	λ_{abs}/nm	λ_{em}/nm	Φ_F	$\Phi_{dec}/10^{-2}$	$k_r/10^5 M sec^{-1}$	$\Phi_{ISC}/10^{-2}$	CO yield	Φ_{ISC}
1A	403	598	(0.72 ± 0.06)	(3.0 ± 0.2)	(4.3 ± 0.1)	(14.0 ± 0.2)	80 ± 5	0.23 ± 0.03
2A	406	605	(0.52 ± 0.02)	(3.6 ± 0.4)	(1.3 ± 0.23)	(11.0 ± 0.8)	80 ± 5	-
3A	409	612	(0.32 ± 0.02)	(2.4 ± 0.3)	(0.56 ± 0.01)	(28.4 ± 0.4)	50 ± 4	-
4A	410	603	(0.63 ± 0.05)	(3.6 ± 0.2)	(2.1 ± 0.1)	(11.0 ± 0.6)	82 ± 5	0.24 ± 0.02
5A	406	599	(0.60 ± 0.03)	(1.7 ± 0.3)	(13.0 ± 0.6)	(7.6 ± 0.1)	65 ± 6	0.22 ± 0.03
6A	411	622	(0.13 ± 0.01)	(13.0 ± 0.9)	(2.9 ± 0.14)	(31.0 ± 2.1)	95 ± 5	0.79 ± 0.04
7A	438	571	(0.25 ± 0.034)	(0.82 ± 0.06)	(28.0 ± 5.2)	(2.82 ± 0.05)	60 ± 1	-
8A	455	613	(0.085 ± 0.006)	(1.3 ± 0.4)	-	(8.6 ± 0.6)*	85 ± 3*	-
9A	414	620	(0.09 ± 0.01)	(16.0 ± 1.1)	-	(24.30 ± 0.02)*	95 ± 5*	-

Compd	λ_{abs}/nm	λ_{em}/nm	Φ_F	$\Phi_{dec}/10^{-2}$	$k_r/10^5 M sec^{-1}$	$\Phi_{ISC}/10^{-2}$	CO yield	Φ_{ISC}
1B	456	635	(0.16 ± 0.01)	(2.1 ± 0.1)	(4.7 ± 0.2)	(7.0 ± 0.2)	61 ± 3	-
2B	461	635	(0.21 ± 0.01)	(1.9 ± 0.1)	(6.5 ± 0.2)	(5.5 ± 0.8)	80 ± 5	-
3B	465	635	(0.23 ± 0.02)	(2.3 ± 0.2)	(4.9 ± 0.18)	(7.0 ± 0.2)	45 ± 2	-
4B	460	635	(0.18 ± 0.01)	(2.2 ± 0.1)	(2.6 ± 0.37)	(7.9 ± 0.3)	54 ± 1	-
5B	461	635	(0.19 ± 0.01)	(1.7 ± 0.1)	(3.6 ± 0.27)	(4.9 ± 0.2)	90 ± 2	-
6B	482	698	(0.039 ± 0.008)	(2.1 ± 0.1)	(3.9 ± 0.03)	(9.5 ± 0.3)	50 ± 3	-
7B	472	634	(0.20 ± 0.01)	(2.1 ± 0.2)	(5.5 ± 0.29)	(5.3 ± 0.6)	72 ± 2	-
8B	511	705	(0.021 ± 0.003)	(1.3 ± 0.1)	-	(2.5 ± 0.4)*	83 ± 3*	-
9B	482	694	(0.0003 ± 0.0001)	(1.1 ± 0.1)	-	(1.1 ± 0.2)*	51 ± 1*	-

II. Substituent Effects



III. Jablonski Diagram



IV. Conclusion

The evaluation of effects of different groups at different positions on the photochemical properties of hydroxyflavones shows that the reactivity is significantly influenced especially by the groups on the naphthalene ring. The major effects involve the shift of the acid-base equilibria, the efficiency of intersystem crossing, and the excited-state lifetimes.

V. References

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