

## Abstract for RTCS-2022(16-18 Dec. 2022)

### **Topic- g-C<sub>3</sub>N<sub>4</sub> Catalyzed Photo-Decarboxylative Functionalization of Benzylic C(Sp<sup>3</sup>)-H with carbonyl moiety: - An Alternative of Grignard's Reaction**

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*PI:* - Dr. Debayan Sarkar, IIT Indore, Madhya Pradesh, India.

*Co-PI:* - Dr. Bimalendu Adhikari, NIT, Rourkela, Odisha, India.

The Grignard reaction is an organometallic chemical reaction in which alkyl, allyl, vinyl, or aryl magnesium halides (Grignard reagent) is added to a carbonyl group in an aldehyde or ketone.<sup>1</sup> We demonstrated a metal free heterogeneous organic semiconductor g-C<sub>3</sub>N<sub>4</sub> catalysed<sup>2,3</sup> and visible light-assisted benzylation of carbonyl moiety. A facile reaction results in the construction of C–C bonds<sup>4</sup> under mild conditions in blue LED irradiation. The catalysis initiates via a radical pathway and involves a ketyl radical anion intermediate.<sup>5</sup> The reaction shows good functional group tolerance with excellent yields. The strategy provides an easy access to these molecules with potential medicinal chemistry applications.

#### **References:**

1. Smith, Michael B.; March, Jerry (2007), *Advanced Organic Chemistry: Reactions, Mechanisms, and Structure* (6th ed.), New York: Wiley-Interscience, ISBN 978-0-471-72091-1.
2. A. Savateev, I. Ghosh, B. König and M. Antonietti, Photoredox catalytic organic transformations using heterogeneous carbon nitrides *Angew. Chem., Int. Ed.*, 2018, 57, 15936–15947.
3. Y. Zheng, L. Lin, B. Wang and X. Wang, Graphitic Carbon Nitride Polymers toward Sustainable Photoredox Catalysis *Angew. Chem., Int. Ed.*, 2015, 54, 12868–12884
4. Hart, D. J. Free-Radical Carbon-Carbon Bond Formation in Organic Synthesis. *Science* 1984, 223, 883–887.
5. Y. Kratish, D. Pinchuk, A. Kaushansky, V. Molev, B. Tumanskii, D. Bravo-Zhivotovskii and Y. Apeloig, *Angew. Chem., Int. Ed.*, 2019, 58, 18849–18853.

# $g\text{-C}_3\text{N}_4$ Catalyzed Photo-Decarboxylative Functionalization of Benzylic $\text{C}(\text{Sp}^3)\text{-H}$ with carbonyl moiety: - An Alternative of Grignard's Reaction



59<sup>th</sup> Annual Convention of Chemists 2022  
International Conference on Recent Trends in Chemical Sciences -2022



Organized by: Indian Chemical Society



Hosted by: Department of Chemistry  
& Chemical Biology, IIT(ISM) Dhanbad

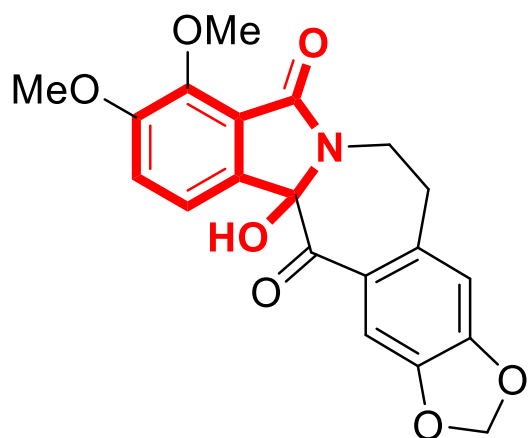
17/12/2022

**SANGITA BISHI**

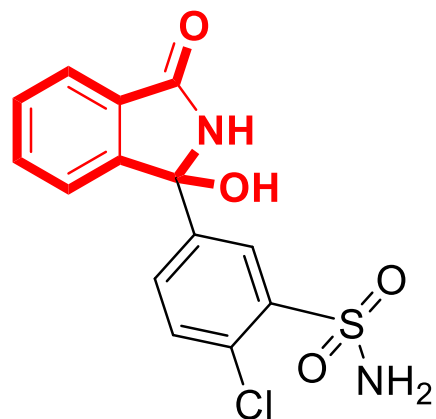
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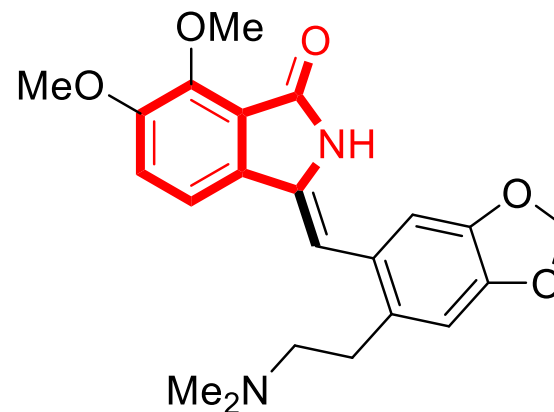
**Biologically active compounds with a 3-hydroxyisoindolinone skeleton(I-IV) and Naturally occurring and FDA-approved isoindolin-1-ones(V-VIII).**



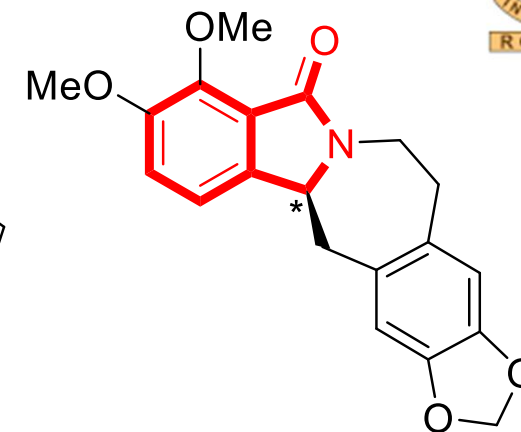
I Chilenine  
(natural compound)



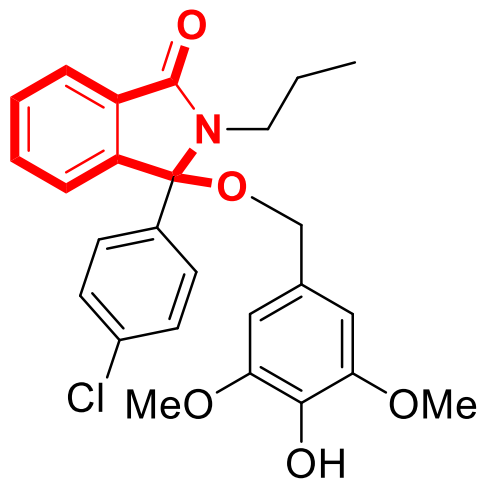
II Chlortalidone  
(antihypertensive drug)



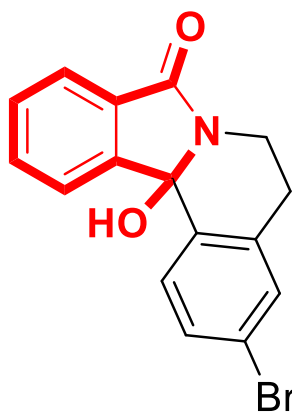
V Fumaridine



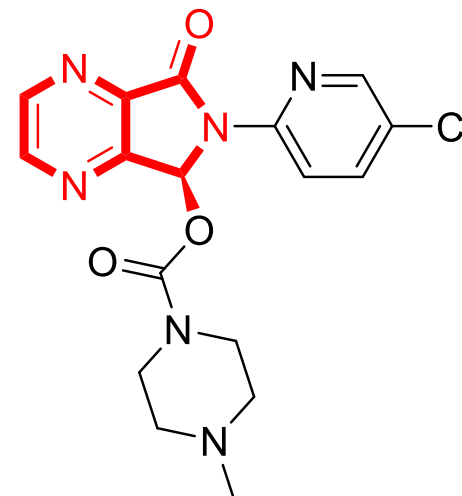
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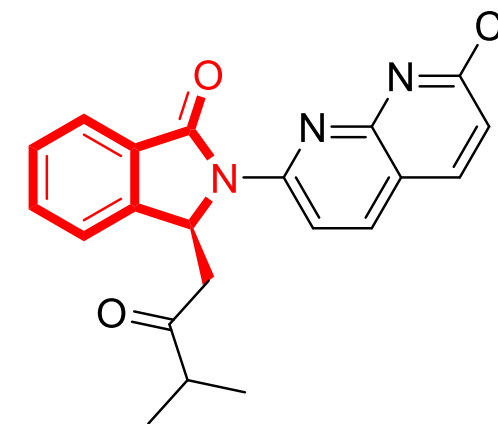
III NU8231  
(MDM2-p53 inhibitor)



IV CRR-228  
(PARP-1 inhibitor)

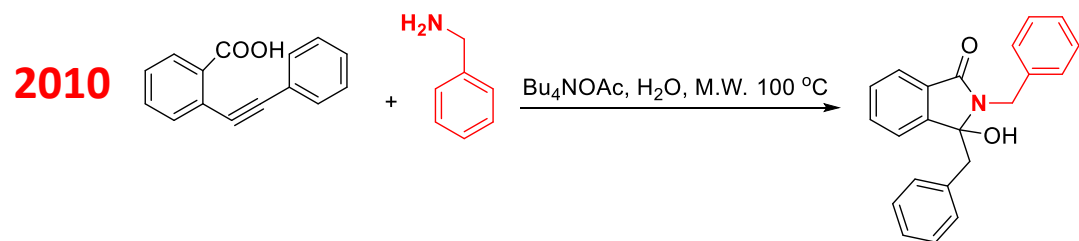


VII Eszopiclone Lunesta  
(Insomnia)  
Sunovion



VIII Pagoclone  
(anxiolytic)

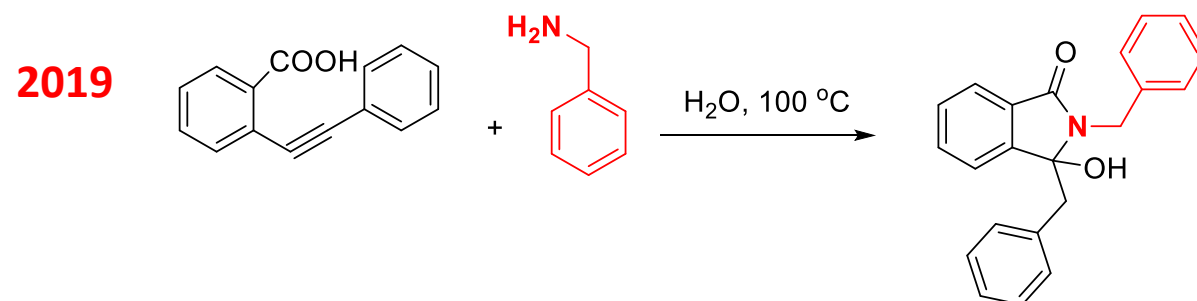
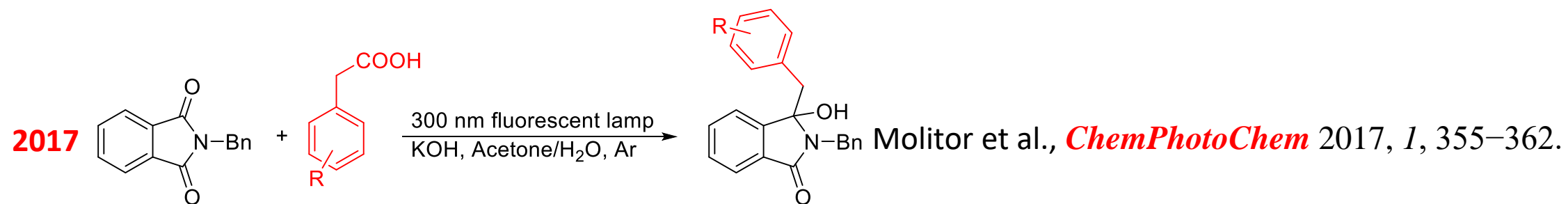
# Literature Survey:



Liu et al., *Green Chem.* 2010, 12, 1397–1404

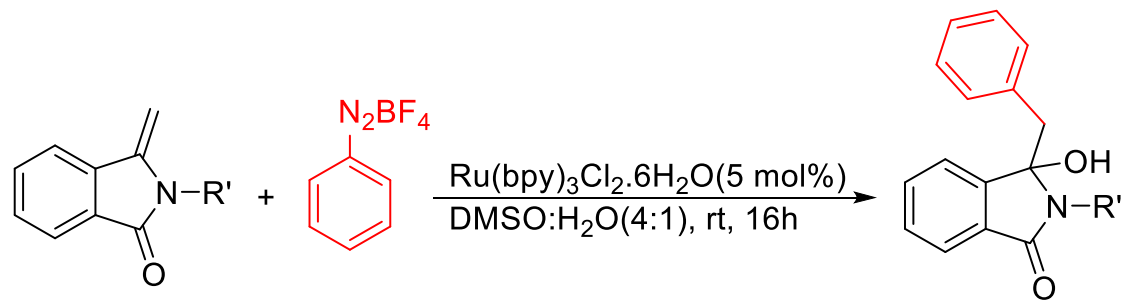


Sakurai et al., *Tetrahedron* 2012, 68, 8805–8816.



Zhao et al. *Asian J. Org. Chem.* 2019, 8, 2073–2091

2022

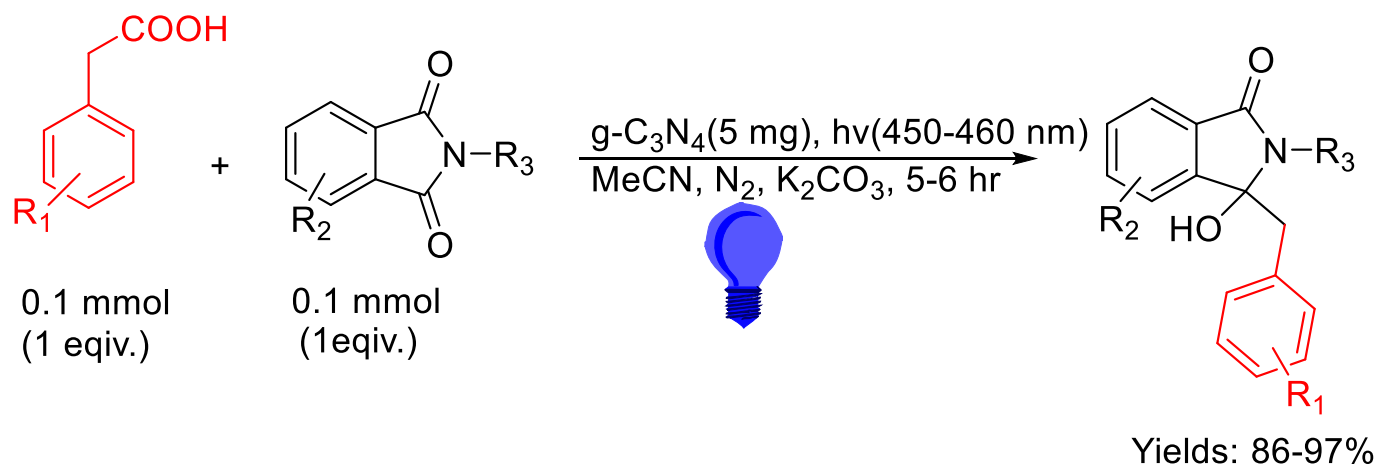


Jain et al., 2022, *J. Org. Chem.*

<https://pubs.acs.org/10.1021/acs.joc.2c00607>

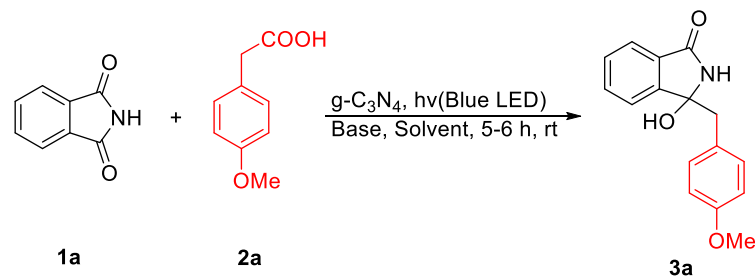
## Our Approach:

### Scheme -1



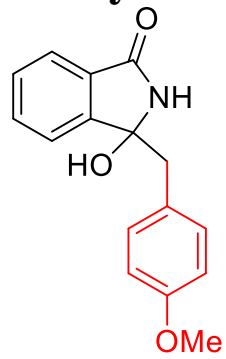
- Sustainable Method (Greener and milder visible light)
- Metal free
- Excellent Yield
- High functional group tolerance
- Recyclable catalyst
- Room temperature
- Durable organic semiconductor photocatalyst Stable in Atm. air
- Less reaction times
- Cheaper substrates
- Structural Diversity

## Optimisation Of Reaction Conditions:

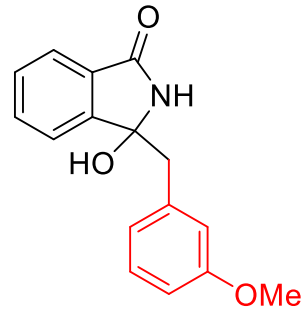


Entry	Photocatalyst (5 mg)	Bases(1 equiv.)	Solvents(3 ML)	Atm. conditions	Light conditions(1 Watt)	Time(h)	Yield (%)
1	g-C <sub>3</sub> N <sub>4</sub>	K <sub>2</sub> CO <sub>3</sub>	MeCN	O <sub>2</sub>	Blue	10	0
2	<b>g-C<sub>3</sub>N<sub>4</sub></b>	<b>K<sub>2</sub>CO<sub>3</sub></b>	<b>MeCN</b>	<b>N<sub>2</sub></b>	<b>Blue</b>	<b>5</b>	<b>95</b>
3	g-C <sub>3</sub> N <sub>4</sub>	K <sub>3</sub> PO <sub>4</sub>	MeCN	N <sub>2</sub>	Blue	6	75
4	g-C <sub>3</sub> N <sub>4</sub>	KHPO <sub>4</sub>	MeCN	N <sub>2</sub>	Blue	6	70
5	g-C <sub>3</sub> N <sub>4</sub>	CaCO <sub>3</sub>	MeCN	N <sub>2</sub>	Blue	6	40
6	g-C <sub>3</sub> N <sub>4</sub>	Na <sub>2</sub> CO <sub>3</sub>	MeCN	N <sub>2</sub>	Blue	6	70
7	g-C <sub>3</sub> N <sub>4</sub>	NaHCO <sub>3</sub>	MeCN	N <sub>2</sub>	Blue	6	60
8	g-C <sub>3</sub> N <sub>4</sub>	K <sub>2</sub> CO <sub>3</sub>	MeCN	N <sub>2</sub>	<b>Green</b>	6	<b>70</b>
9	g-C <sub>3</sub> N <sub>4</sub>	K <sub>2</sub> CO <sub>3</sub>	MeCN	N <sub>2</sub>	<b>Dark</b>	6	<b>0</b>
10	g-C <sub>3</sub> N <sub>4</sub>	K <sub>2</sub> CO <sub>3</sub>	EtOAc	N <sub>2</sub>	Blue	6	60
11	g-C <sub>3</sub> N <sub>4</sub>	K <sub>2</sub> CO <sub>3</sub>	DCM	N <sub>2</sub>	Blue	6	50
12	g-C <sub>3</sub> N <sub>4</sub>	K <sub>2</sub> CO <sub>3</sub>	THF	N <sub>2</sub>	Blue	6	50
13	g-C <sub>3</sub> N <sub>4</sub>	K <sub>2</sub> CO <sub>3</sub>	Toluene	N <sub>2</sub>	Blue	6	40
14	g-C <sub>3</sub> N <sub>4</sub>	K <sub>2</sub> CO <sub>3</sub>	Methanol	N <sub>2</sub>	Blue	6	0
15	g-C <sub>3</sub> N <sub>4</sub>	K <sub>2</sub> CO <sub>3</sub>	1,4-dioxane	N <sub>2</sub>	Blue	6	40
16	g-C <sub>3</sub> N <sub>4</sub>	K <sub>2</sub> CO <sub>3</sub>	H <sub>2</sub> O	N <sub>2</sub>	Blue	6	0
17	-----	K <sub>2</sub> CO <sub>3</sub>	MeCN	N <sub>2</sub>	Blue	6	<b>0</b>

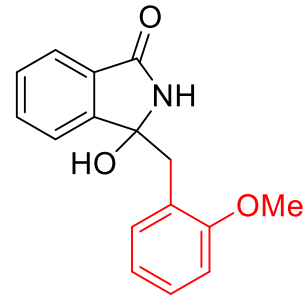
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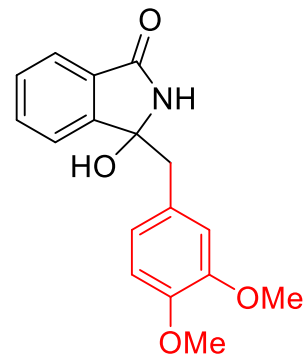
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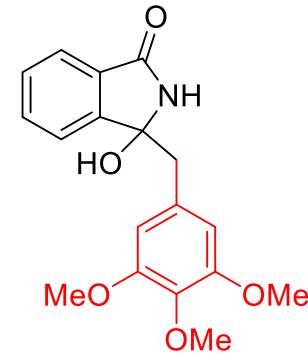
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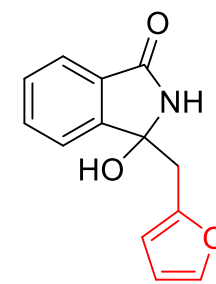
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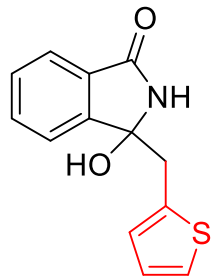
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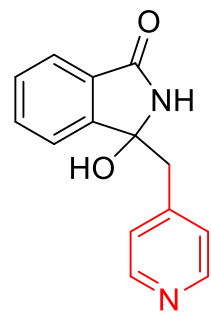
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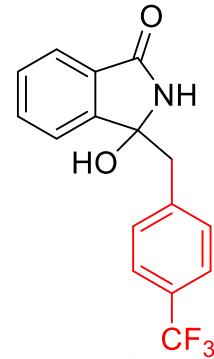
f 87%



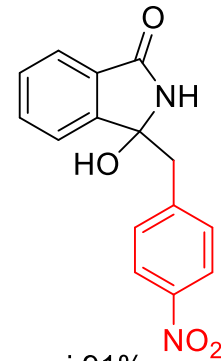
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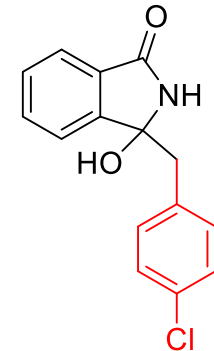
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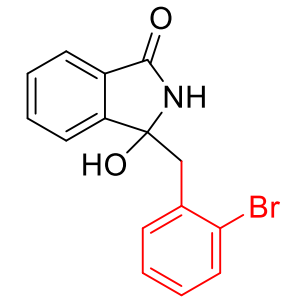
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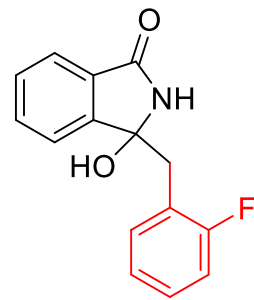
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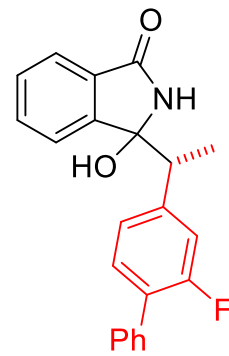
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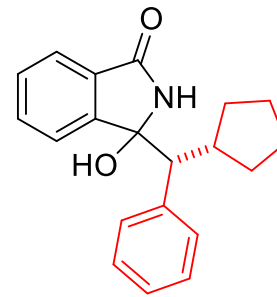
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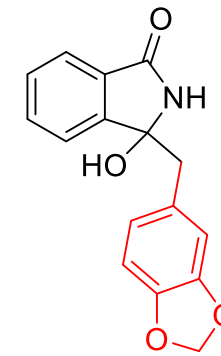
m 89%



n 96%  
From Flurbiprofen



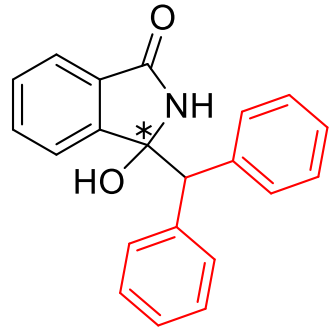
o 94%



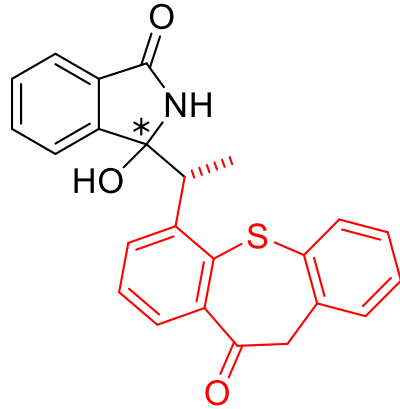
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**\*>99%de**

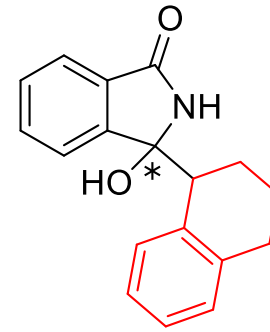
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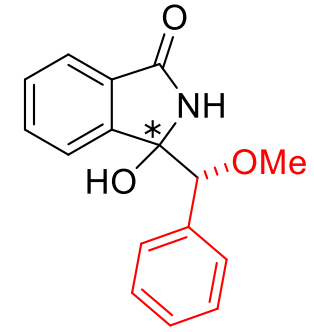
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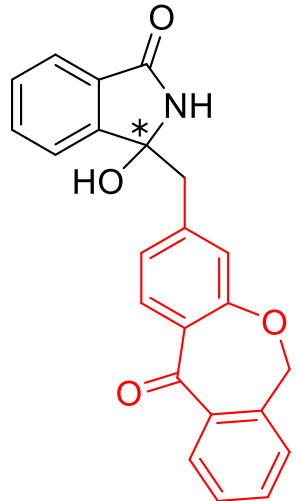
r 91%  
From Zaltoprofen



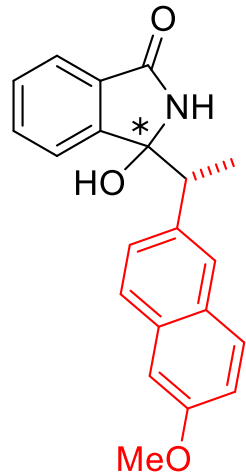
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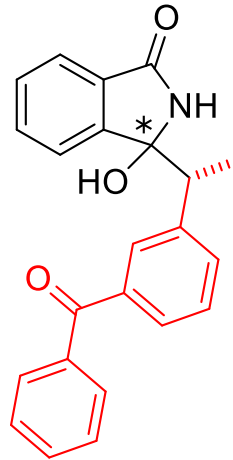
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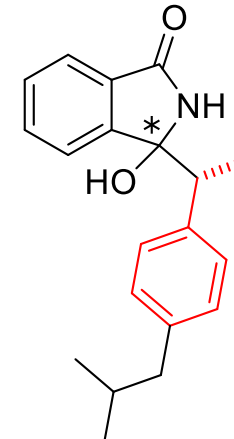
u 90%  
From Isoxepac



v 93%  
From Naproxen



w 95%  
From Ketoprofen



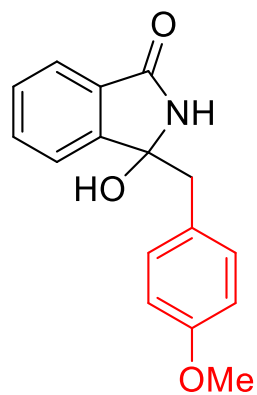
x 96%  
From ibuprofen



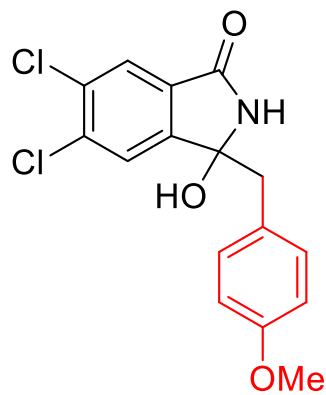
**\*>99%de**



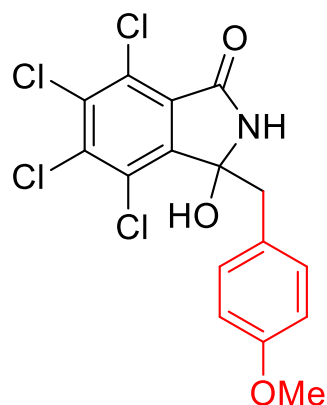
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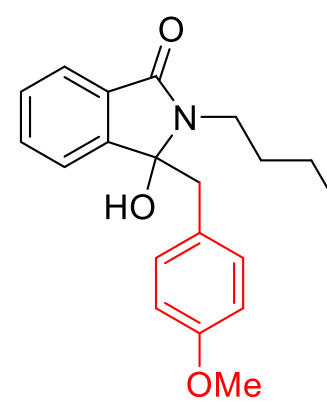
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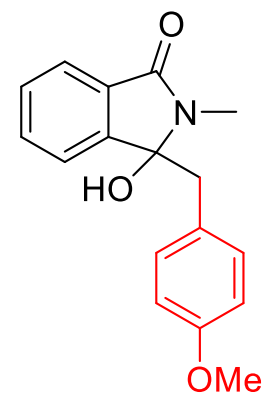
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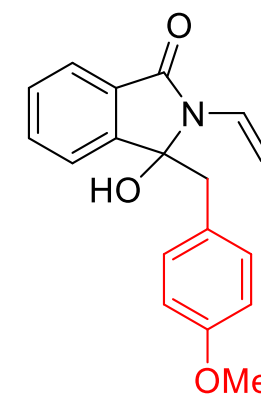
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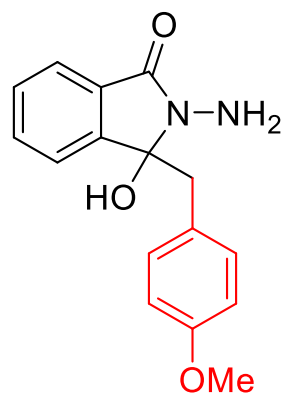
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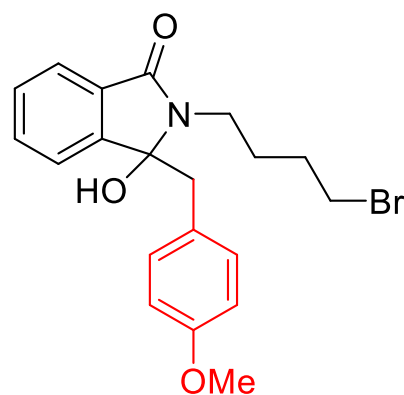
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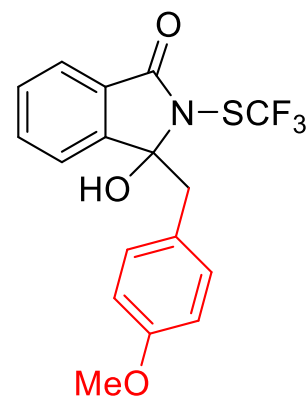
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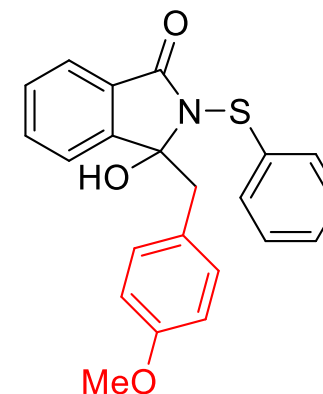
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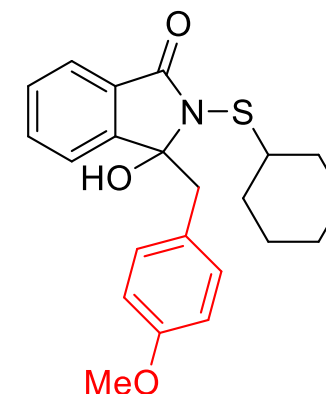
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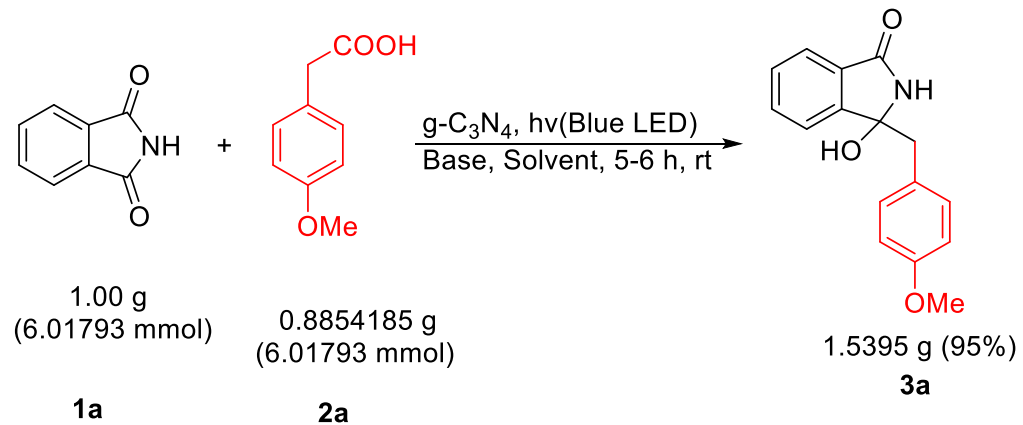


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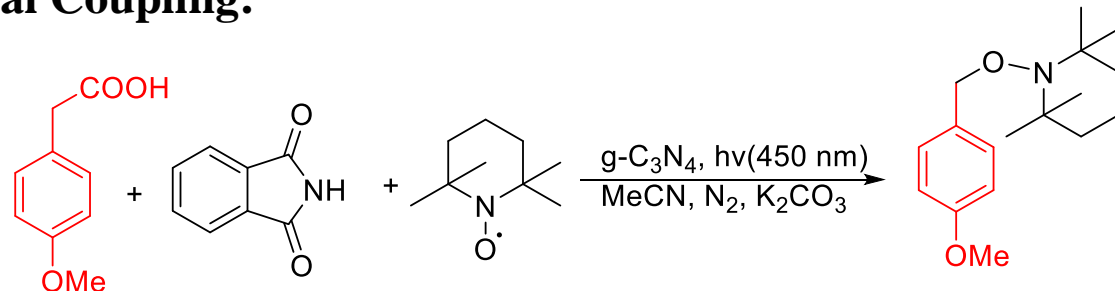


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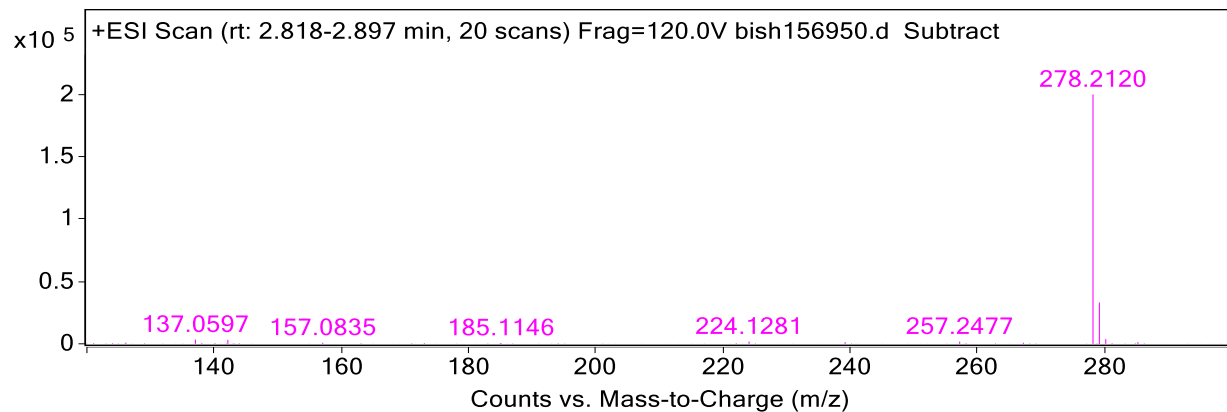
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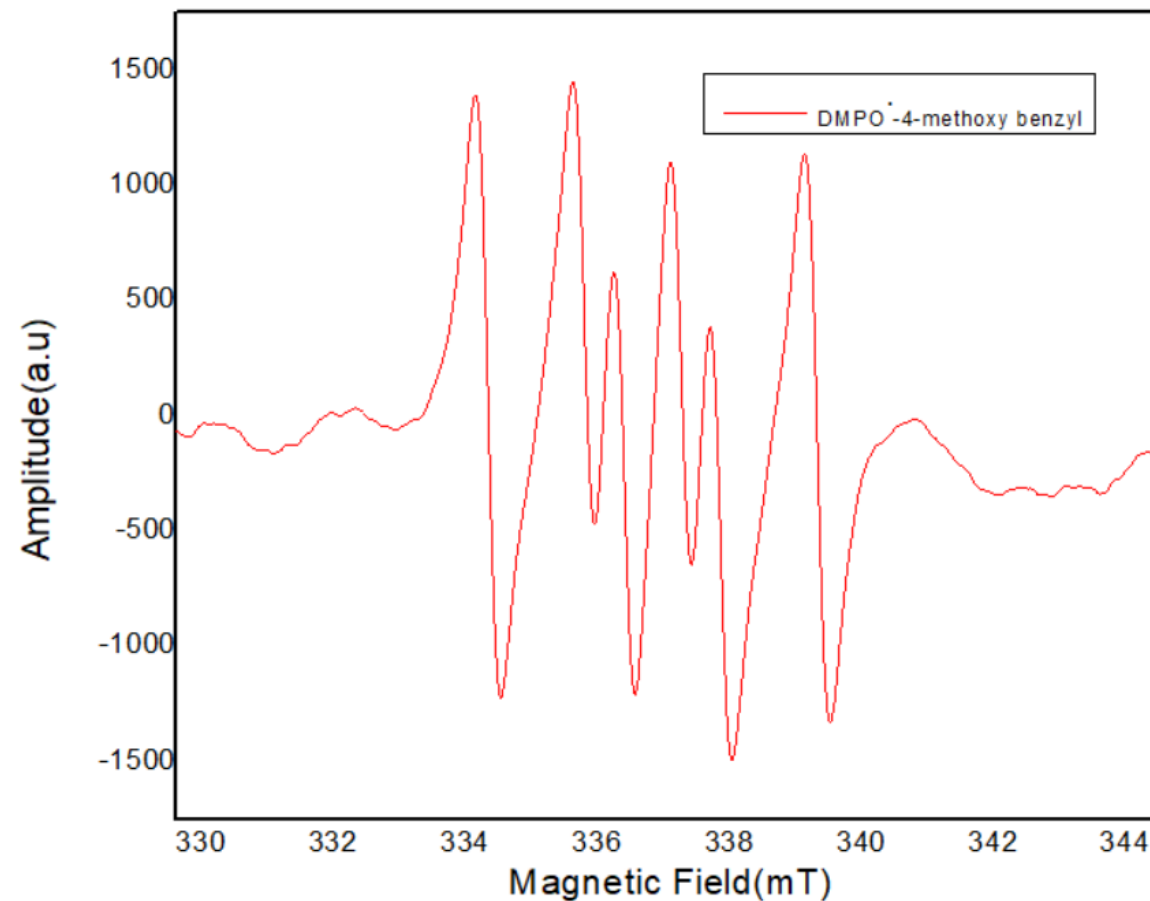
## Radical Coupling:



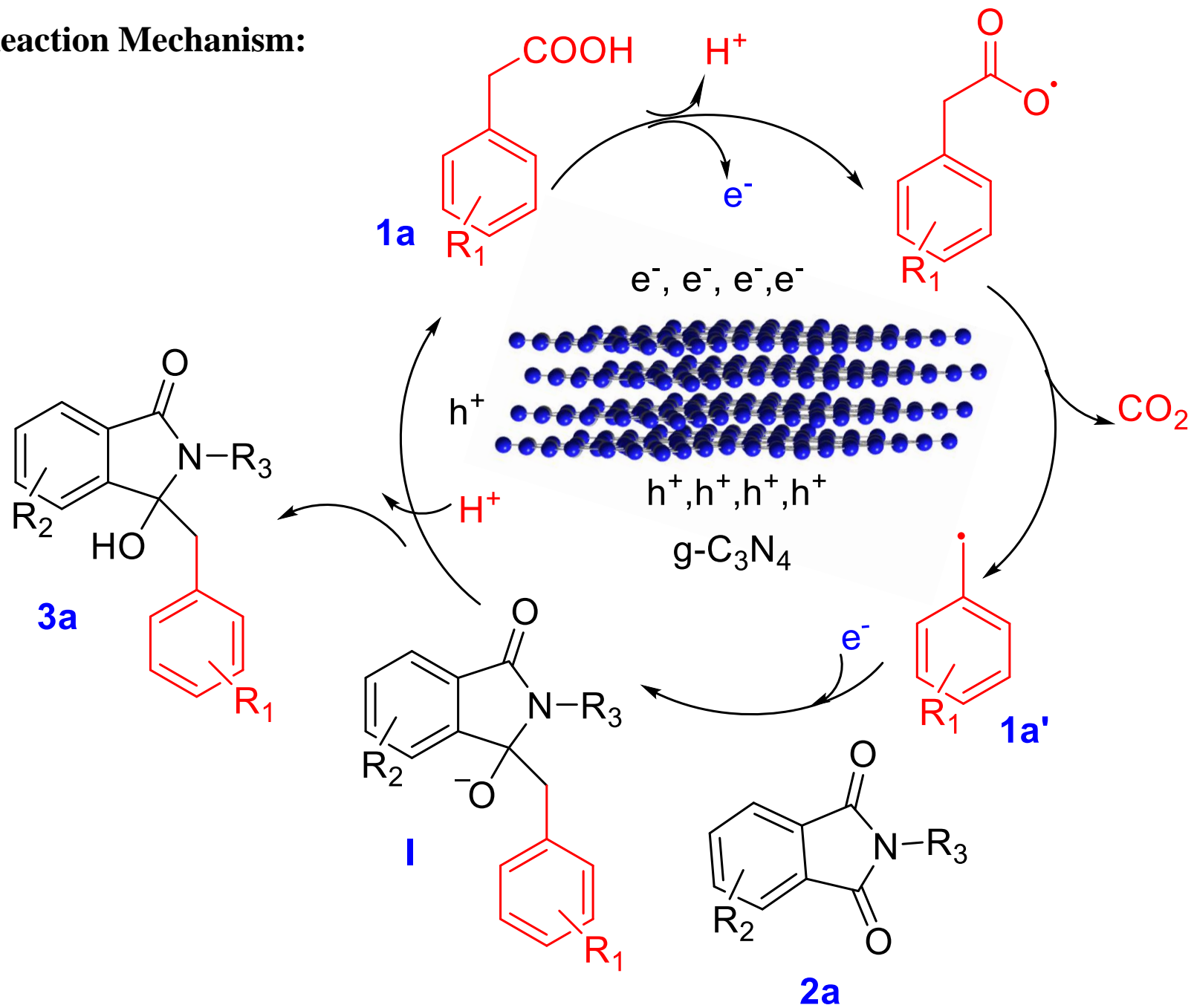
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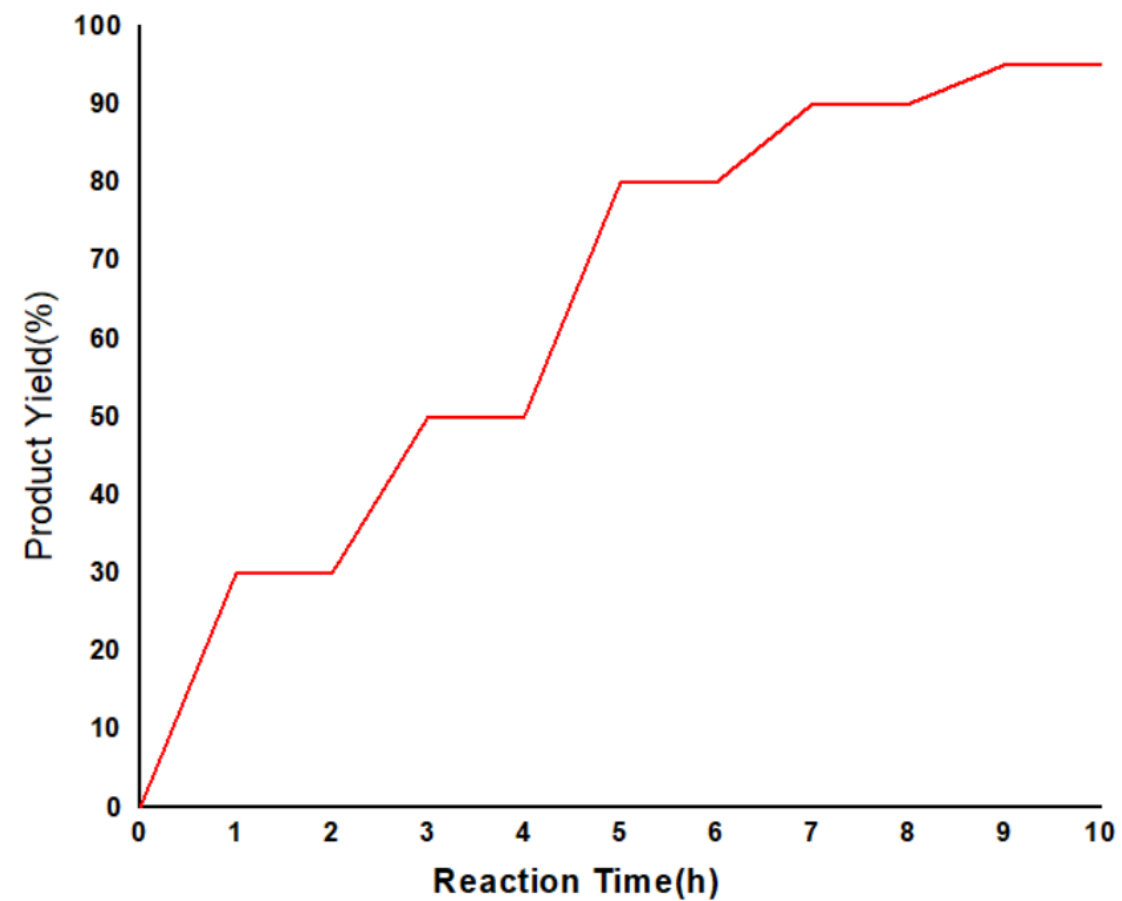


## ESR Study

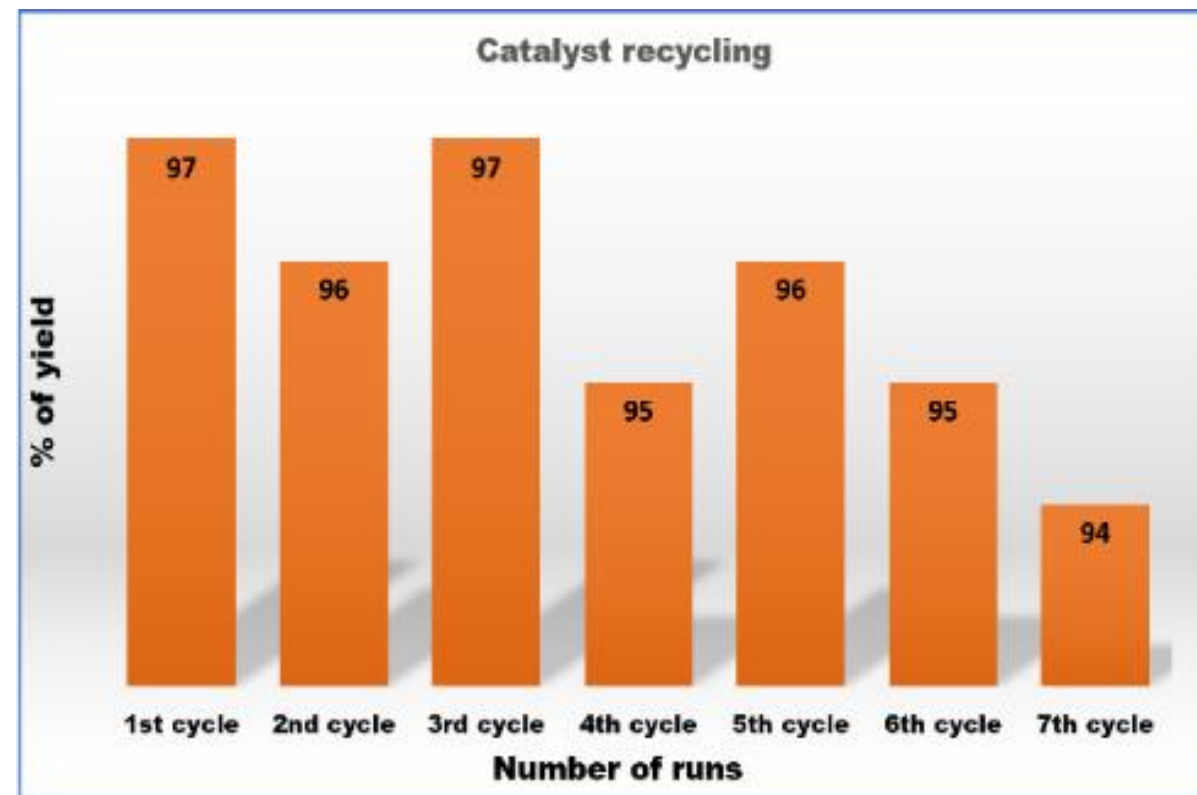


# Proposed Reaction Mechanism:



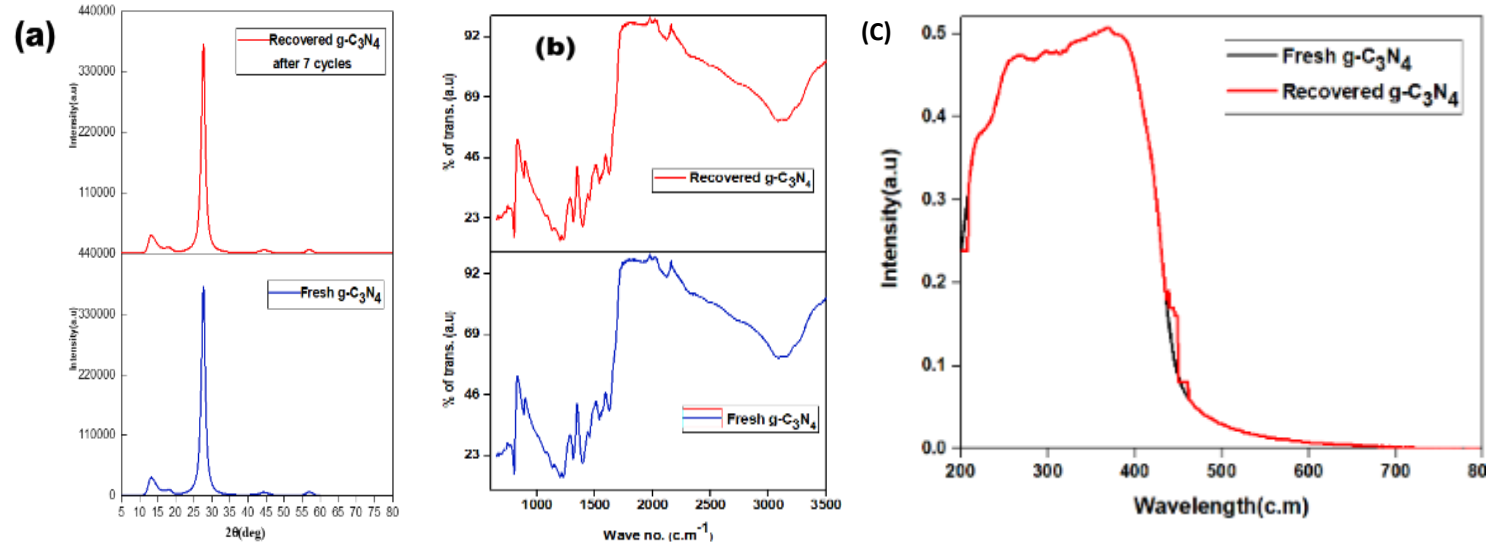


**Light on/off Experiment**

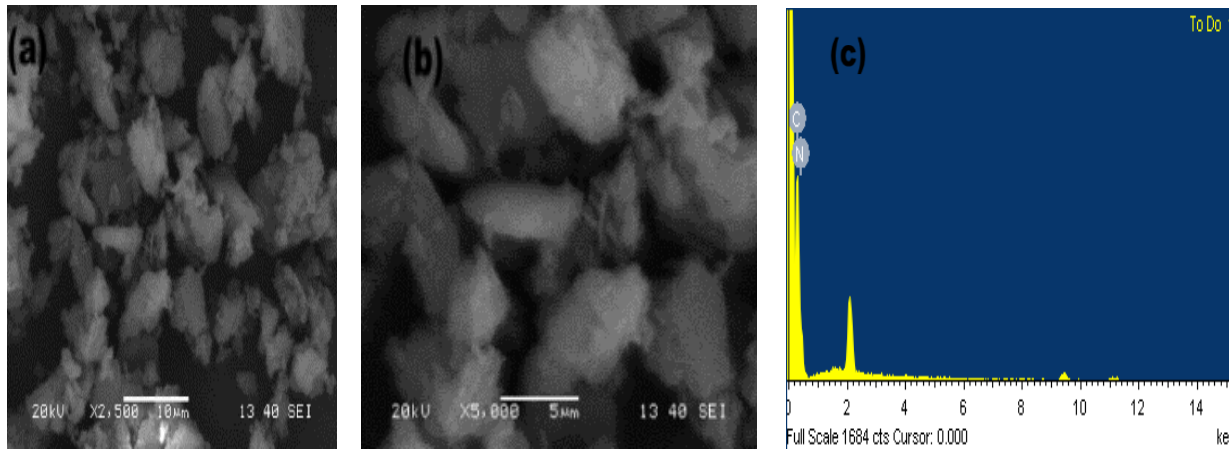


**Evaluation of catalytic recycling of g-C<sub>3</sub>N<sub>4</sub> for the synthesis of ab.**

# Recycling of Catalyst



**Figure 1.** (a) XRD pattern, (b) IR and (c) UV-vis diffuse reflectance spectra (UV-vis DRS) of fresh g-C<sub>3</sub>N<sub>4</sub> and recovered g-C<sub>3</sub>N<sub>4</sub> after 7 cycles.



entry	Elements	Weight (%)	Atomic (%)
1	C K	42.91	46.71
2	N K	57.09	53.29
<b>Totals</b>		<b>100.00</b>	

**Figure 2.** (a) and (b) SEM images of fresh g-C<sub>3</sub>N<sub>4</sub> and recovered g-C<sub>3</sub>N<sub>4</sub> after 7 cycles, (c) EDS image and (d) Surface atomic ratios of all elements measured by EDS of fresh and recovered g-C<sub>3</sub>N<sub>4</sub>.



## Conclusion:

- we demonstrated a heterogeneous  $g\text{-C}_3\text{N}_4$  catalysed and visible light-assisted arylation of phthalimide.
- A facile reaction results in the construction of C–C bonds under mild conditions under blue LED irradiation.
- The reaction shows good functional group tolerance and yields 3-benzyl-3-hydroxyisoindolin-1-one derivatives in excellent yields.
- The strategy provides an easy access to these molecules with potential medicinal chemistry applications

## Publications:

1. Kundu, S.; **Bishi, S.**; Sarkar, D., Introducing C2–Asymmetry in Chromans – A Brief Story†, *NJC*, **2022**  
DOI: [10.1039/D2NJ00944G](https://doi.org/10.1039/D2NJ00944G).

2. Bera, K.N.; Lenka, S. B.; **Bishi, S.**; Samanta, S.; Sarkar, D., Gold(I)-Catalyzed Synthesis of Heterocycles via Allene Oxide from Propargylic Alcohols *J. Org. Chem.* **2022**, DOI: [10.1021/acs.joc.2c00780](https://doi.org/10.1021/acs.joc.2c00780).

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**Supervisor**

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Indore, MP, India**



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