

Indian Science Technology and Engineering facilities Map (I-STEM)

Application for

1. Partial financial support for using R&D facilities in other institutions through the I-STEM web portal to Users from Academic Institutions and Start-ups (Format-1)

Requesting support for accessing and using facilities through the I-STEM web portal.

(i) Details of the Personal Information

- a. Name of the Researcher : **HARSHITHA.D.H**
- b. Name of the Institution: **BANGALORE UNIVERSITY**
- c. Name of the Department: **DEPARTMENT OF PHYSICS**
- d. Degree registered for : **Ph.D. (Research Scholar)**
- e. Mob. No. **8197914229** f. Email ID: **harshithadh@bub.ernet.in**

(ii) Project/Research topic Details:

- a. Project Title/Research Title: **Synthesis and structure determination of heterocyclic compounds by analytical techniques.**
- b. Sub area: **Physics**
- c. Area Description: **Crystallography**
- d. Aims & Objective (in Bullets):

AIM

Within the scientific context, this research work is a modular synthetic approach to novel molecular entities, which has a growing number of applications prevalent in all modern areas of physics and chemistry, from drug discovery to materials science.

OBJECTIVES

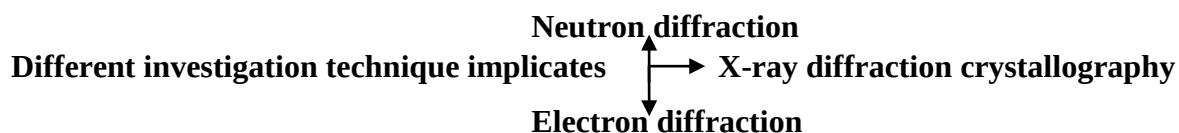
- To synthesize the organic compound relevant to the present work.
- To grow single crystals of the synthesized products.
- To collect data of for mass confirmation and purity.
- To collect 3d-intensity data using a single crystal diffractometer.
- Different activities like QSAR (Quantitative Structure Activity Relationship), DFT (Density Functional Theory), Hirshfeld surface analysis (quantitative study of the intermolecular interactions of the molecules in a crystal structure) and antibacterial importance will be analyzed and discussed.

e. Duration (MM/YYYY): **09/2022 to 04/2023**

f. Project Summary (1000 words):

INTRODUCTION

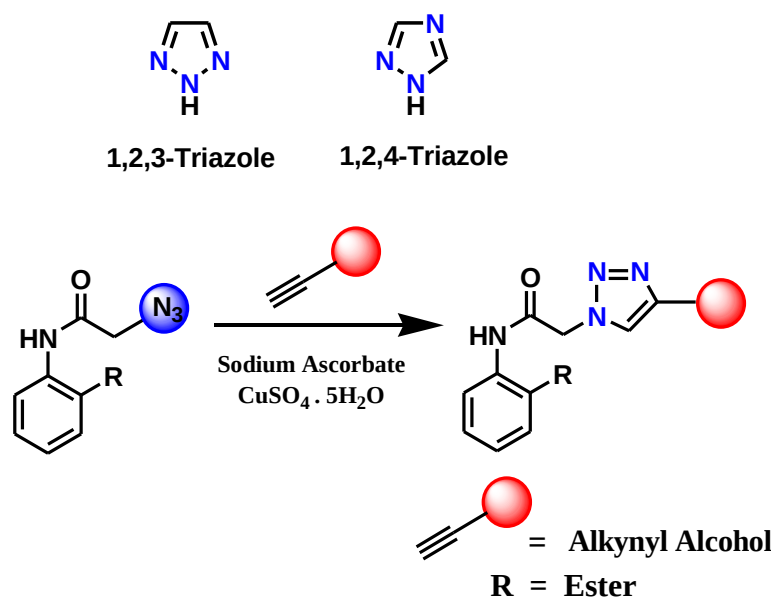
- Crystallography is the experimental science of determining the arrangement of atoms in crystalline solids. Before the development of X-ray crystallography, the study of crystals was based on physical geometry measurements.
- The crystallographic methods currently depend on analyzing the diffraction patterns of the targeted specimen.



- The techniques used after the formation of the crystal involve a diffraction beam to collect the data for the determination of structure and its inter-atomic spacing. The natural shapes of the crystal reflect the atomic structure imperative for crystallographic measurements.
- Experimental work involves the synthesis of the chemical compound in the laboratory and the crystal growth for analysis and characterization^[1].

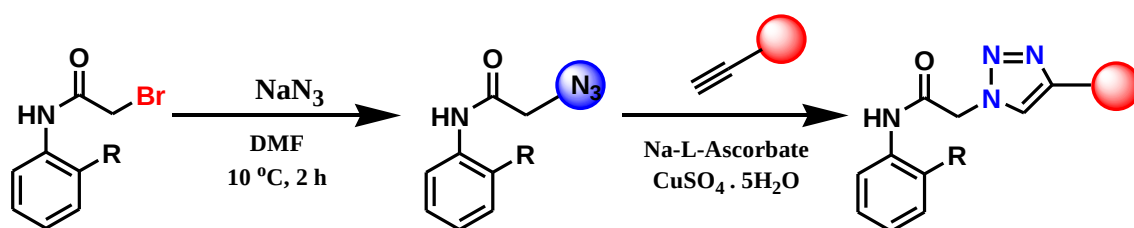
TRIAZOLES

Triazoles are biologically active heterocyclic scaffolds with the molecular formula $C_2H_3N_3$ and are considered a mimic of the peptide bond. They exhibit substantial isomerism depending on the position of the nitrogen atoms in its ring. Two possible isomeric forms are 1,2,3-triazole and 1,2,4-triazole, containing two carbon and three nitrogen atoms in its five-membered ring structure.



The synthesis of the above heterocyclic compounds will utilize regiospecific click chemistry^[1], which accomplishes simplicity, selectivity, and biocompatibility by carbon-hetero bond formation reactions. These derivatives at positions [1,2,3] have potential scientific prospects in agriculture, medical chemistry, material science, physical science, and pharmaceuticals.^[2] The synthesized compounds have to be characterized by LC-MS for structural integrity, NMR for identification and conformation of the structure of organic compounds, and XRD for identifying the molecular form of a single crystal. As a future direction, we plan to screen the compounds to evaluate their purity or quantify the mixture's components through HPLC and detect the unknown or elemental compositions of the compounds through HRMS. We also synthesize other variants to study their biological activities and to adopt different crystal procedures in the future for further studies.

SYNTHETIC SCHEME



Two aspects of click reaction involve SPAAC and CuAAC. Triazole formation can be catalyzed by Cu catalyst or by using strained alkyne.^[3] In our research, we focus on CuAAC and its prominence in its quantitative fictionalization. Cu(I)-Catalysed azide-alkyne cycloaddition that affords 1,4-disubstituted triazole is a prototypical example of a bio-orthogonal click reaction of an azide and a terminal alkyne. This reaction helps to model and implement the synthesis of cyclic peptides and peptidomimetic scaffolds of triazole moieties.

SYNTHETIC PROCEDURE

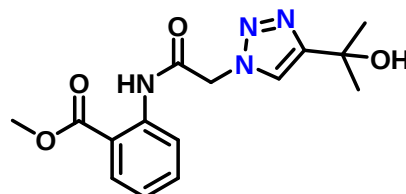
Prevalent to an efficient two-step reaction in which the first step consists of bromo-intermediate compound dissolved in 10ml DMF and stirred at low temperature (10-20°C). Sodium azide was weighed, added slowly, and stirred for more than 2hrs. TLC monitored the reaction process for total consumption. The resulting reaction mixture was quenched, and the white precipitates were filtered, washed with water, and dried under a vacuum. For the click reaction in the second step, the azide compound was treated with 2-Methyl-3-Butyn-2-ol in the presence of saturated CuSO₄ solution and sodium ascorbate in DCM

to facilitate 1,4-disubstituted-1,2,3-triazole in good yield at mild aerobic conditions. The synthesized triazole compound has been characterized by LC-MS for structural integrity. Crystallization at room temperature with different solvents to observe the crystal growth for further studies.

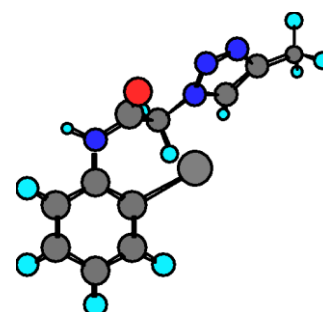
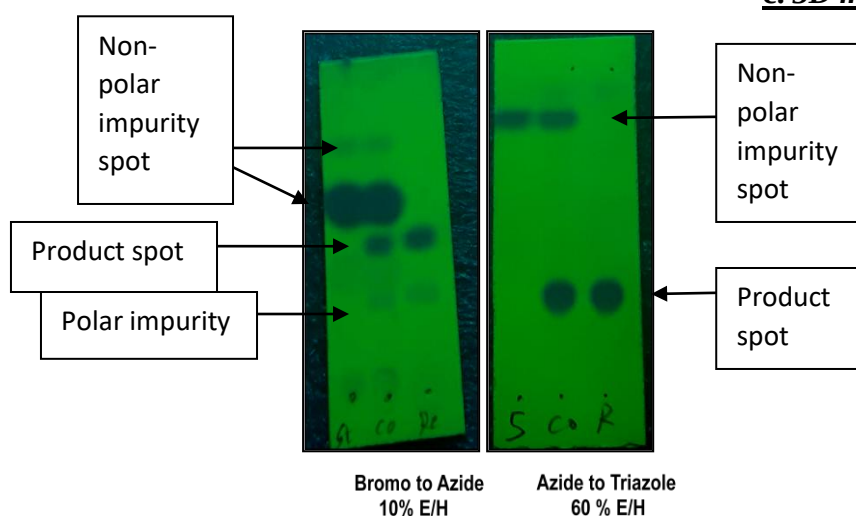
a. Thin Layer Chromatography

- Chromatography is a physical method of separation to separate organic compounds.
- Analysis under normal pressure and room temperature.

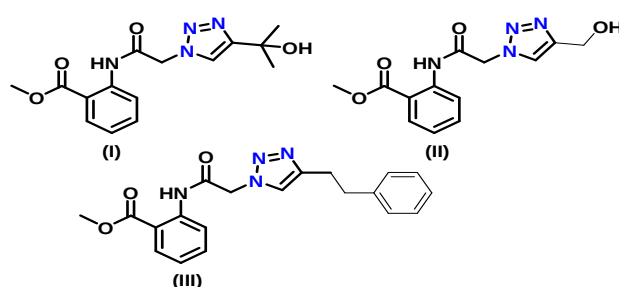
b. Chemical structure of the triazole compound



c. 3D model of the above triazole compound



d. Chemical structure of triazole



FUTURE DIRECTIONS AND CONCLUSIONS:

- As a future direction, we plan to synthesize novel triazole variants.
- Crystallization of the compound at room temperature through slow evaporation technique for crystallographic studies.

REFERENCES:

1. Dr.P.SanthanaRaghavan & Dr.P.Ramsamy, "Crystal Growth Processes and Methods", KRU Publications., 1999; 35-39.
2. Kolb, Hartmuth C, et al. *Angew. Chem.*, 40, 2004, 35-40.
3. Liyuan Liang, *Coordination Chemistry Reviews*, 255, 2011, 2933-2945.
4. Nicolò Zuin Fantoni, *Chemical Reviews* ., 121, 2021, 7122-7154.

g. **Technical Details**

- a. TRL : TRL 1 – TRL 2 (Basic technology research)
b. Methodology : WORK PLAN

AIM 1	Literature survey and synthesis of the organic compounds
AIM 2	Growing crystals, data collection, structure solution, structure refinement and conformation studies
AIM 3	Hirshfeld analysis, QSAR, DFT and MOPAC

- c. Facilities and Instrumentation required :

NMR facility (IISc, Bengaluru; IITM, Madras)	Liquid Chromatography Mass Spectrometry facility(IISc, Bengaluru)	XRD 1. IISc (Bengaluru) 2. STIC, CUSAT (Kerala,India) 3.IISERB (CIF, Bhopal) 4. IITM (Madras)	HRMS (IISc, Bengaluru)	HPLC (IISc, Bengaluru)
1.Solid-state NMR Spectrometer(400) 2.FT NMR Spectrometer(BRUKER AVIII 500)	LCMS/MS facility for small molecule	1.Single XRD (Bruker D8 Venture). 2.SC-XRD 3.Single Crystal XRD (Kappa APEX II Or Smart APEX II Ultra)	Impact HD (Bruker) ESI QTOF high resolution mass spectrometer	High Performance Liquid Chromatography (LCMS HPLC)

- c. Consumables (Scientific materials) :

Sl.No	Consumables
1.	Beakers, test tubes, cuvettes, conical flasks, glass wares
2.	Aluminium sheets, petri dishes, filtration, balances
3.	Pipettes, buckner funnel, separatory funnel, burette, crucibles, vials
4.	Gloves, face masks, lab coat, tapes, labels, goggles, wipes, cotton wool, scissors, paper rolls
5.	Silica gel 60-120µm; 100-200 µm, Merck silica gel 60, F254
6.	Storage solvents(reagents) & chemicals
7.	Common lab buffers
8.	Distilled water

g. **Expected output and outcome:** **50,000/-**

h. **Funding required from I-STEM :**

Details of Requirements & Mode of the Engagement:

(i) Short term Engagement:

a. Usage of testing/characterization facilities across the country (Characterization Mode)

i. Testing Charges: **40,000/-**

ii. Consumable charges: **10,000/-**

iii. Travel Cost (Boarding and Lodging, if any)- NO

Details of User's Bank Account: SBI

(Please send a copy of the cancelled cheque/copy of the passbook carrying all the information needed)

No	- Closure	in/in	- Interest	S/D/W/H/o	- Son/Daughter
Coll	- Collection	lon/in	- Loan	tr/trf/xfer	- Transfer
Comm.	- Commission	min	- Minimum	TT	- Telegraphic Transfer
COR/CORR	- Correction	os	- Outstanding	txn	- Transaction
CR	- Credit	P&T	- Postage & Telegram	wdl	- Withdrawal
cash	- Cash	Pos	- Point of Sale	+MOD BAL	- total balance (SB+li)

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Nom Reg No: 0000000277546836
Customer's PAN: ATSPH6025R
Date of Issue: 08/11/2019
FIRST

Name: Ms. HARSHITHA D H
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Account No.: 38906181577
A/c Type : LOTUS SAVING BANK AL OVD CHQ
Address : D/O DODDAHANUMALAH B H
#245, MADHUGIRI TAL BIJAVARA
TUMKUR

Phone No. :
Email :
D.O.B. (If Minor):
PPO Number :



Beneficiary Name (User's name) : HARSHITHA.D.H

PAN: ATSPH6025R

Bank Account No. 38906181577

Name of the Branch: SBI

IFSC Code: SBIN0040211

Note: Proposed proposal must be executed within stipulated duration (max. 6 month) to avoid fund availability issues. Travel form will be provided by the I-STEM office. The users will submit the technical report, original invoice (duly signed by the Head of the Institution) raised by the Host Institution through I-STEM portal only along with a copy of the travel forms and original tickets through post to the Nodal Officer, I-STEM, Indian Institute of Science, Bangalore. A scan copy of all the documents may be sent in advance.