THERMOCHROMIC COMPOUNDS AS SENSORS FOR HIGH STRAIN EXPERIMENTS

Joseph Sanz, Chemistry

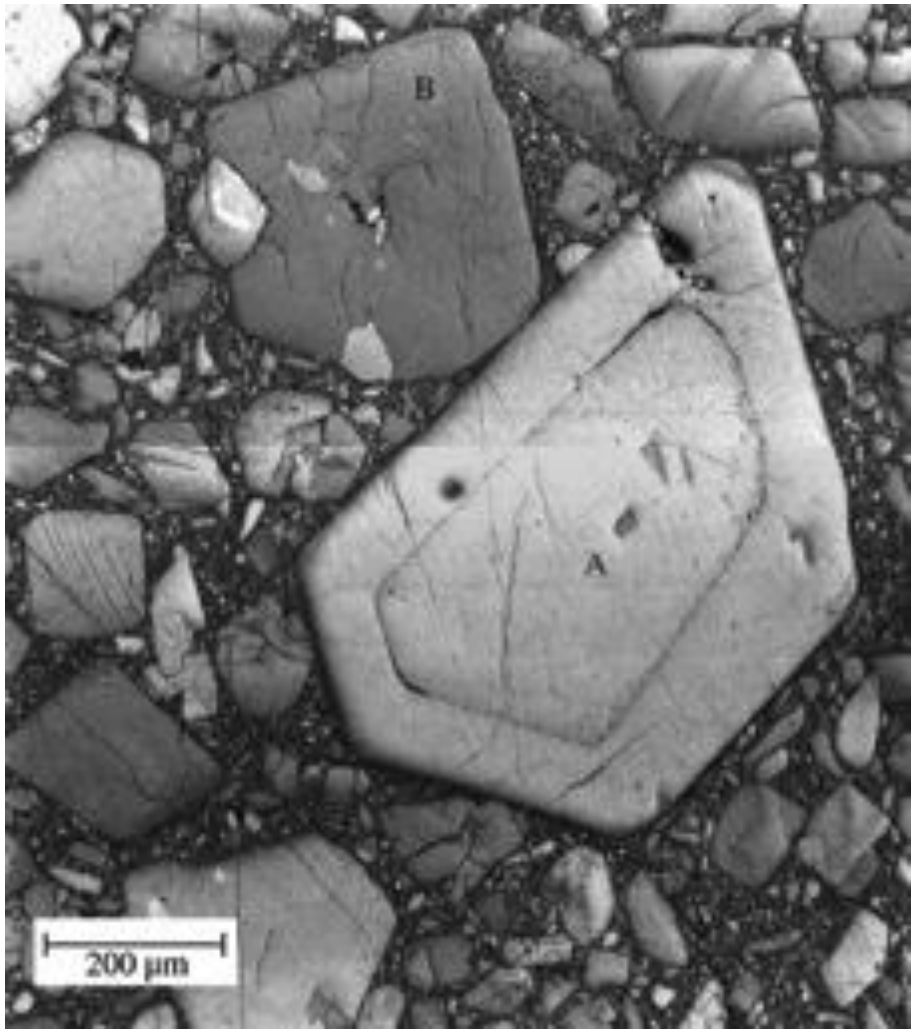
Jimmy Hemmer, Javier Read de Alaniz

Department of Chemistry and Biochemistry

Polymers Are Used For Safety In Everyday Life

Sources: Boeing, Hivehealthmedia, Telegraphnews

Polymers Can Help Make Munitions Safer

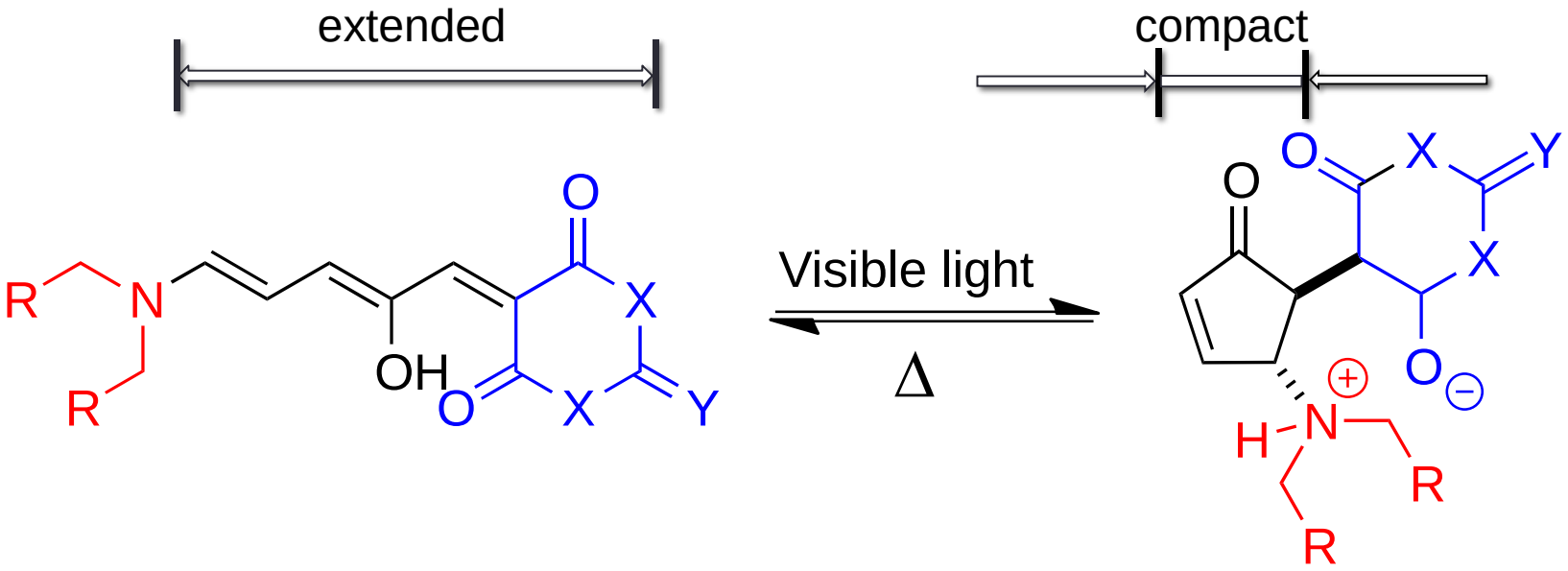


SEM Image of an Explosive Formulation

Photo from Joe Hooper

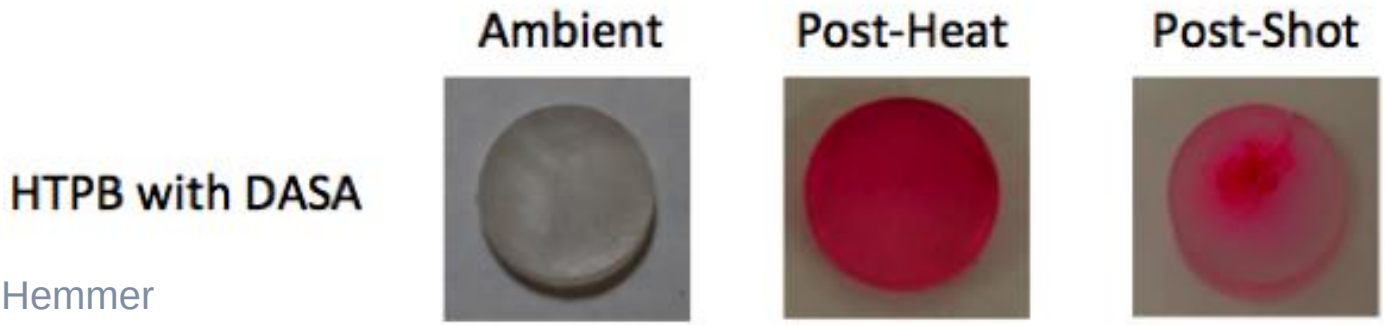
- Unintentional detonation is an important military safety concern
- Hot Spots (>700K) are source of explosive initiation
- HTPB is a polymer used to bind explosives together

Donor Acceptor Stenhouse Adducts (DASAs) As Thermochromic Sensors In Polymers



hydrophobic & colored

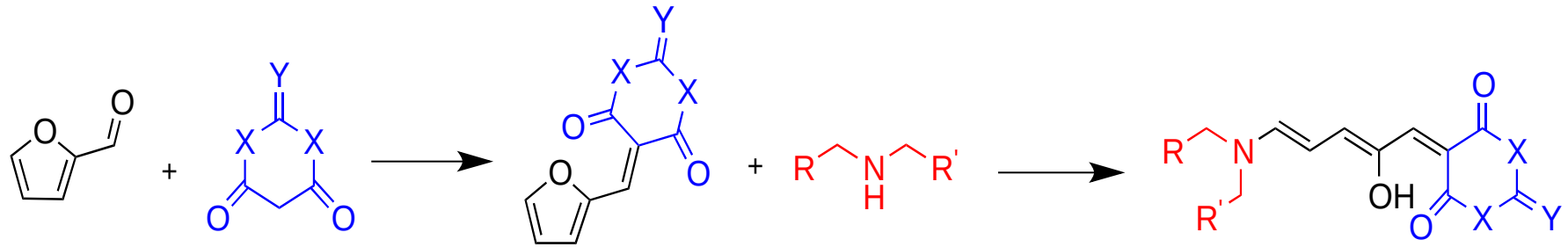
hydrophilic & colorless



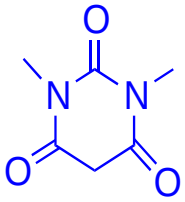
Images from James Hemmer

Overall Synthesis Plan Of DASAs

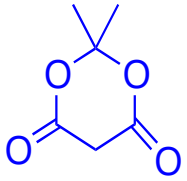
General Scheme of DASA Synthesis



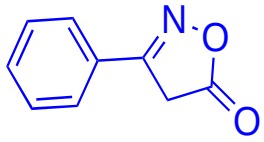
Carbon Acids (Acceptor)



Barbituric Acid

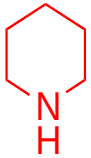


Meldrums Acid

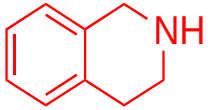


PIO

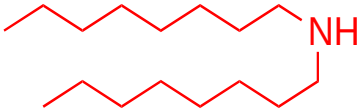
Secondary Amines (Donor)



Piperidine

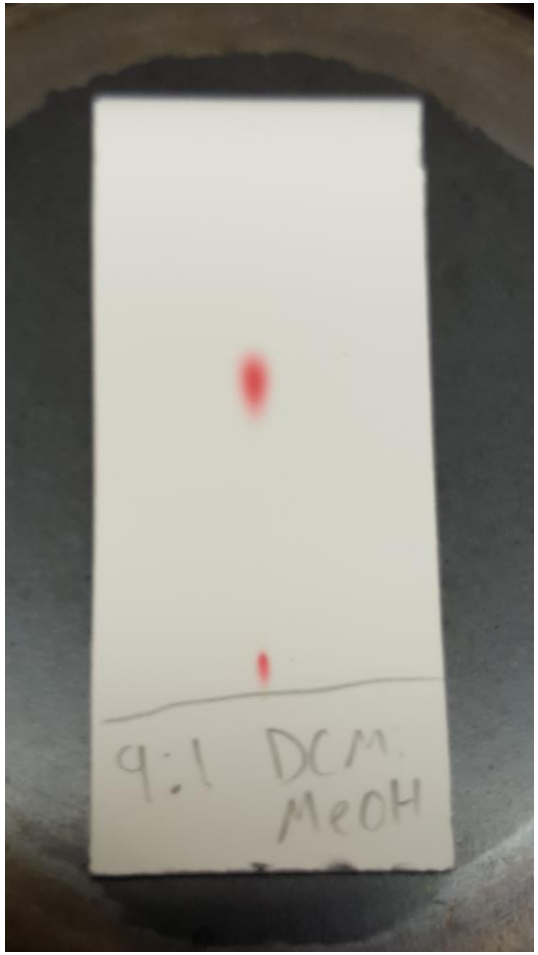


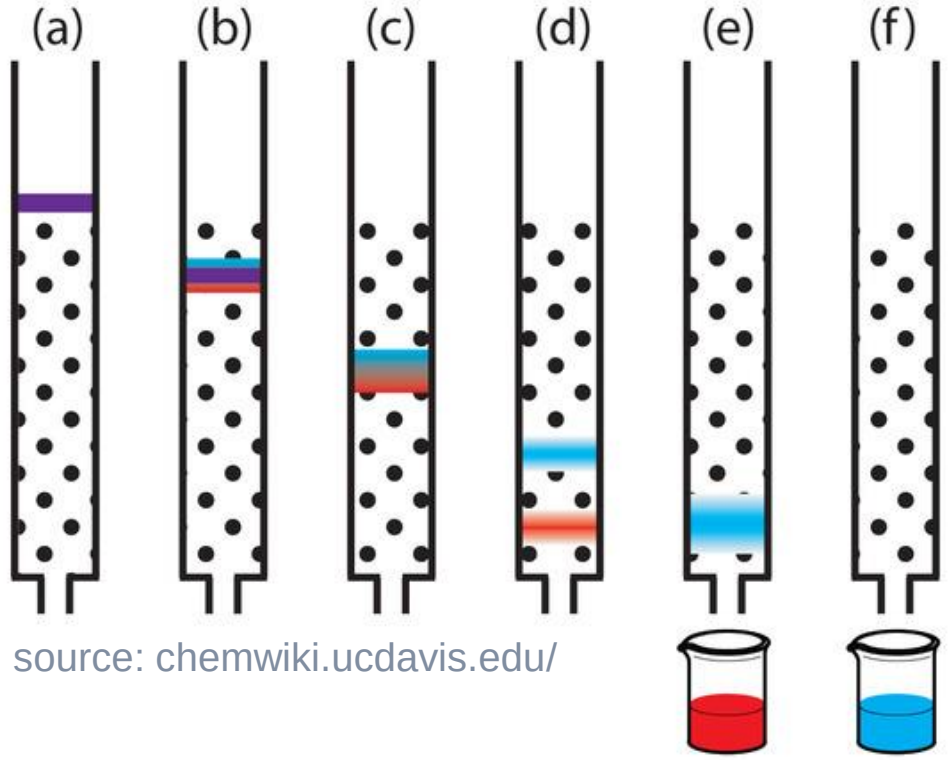
THIQ



Dioctylamine

Thin Layer Chromotograpy (TLC) For Reaction Analysis And Column Chromatography For Purification



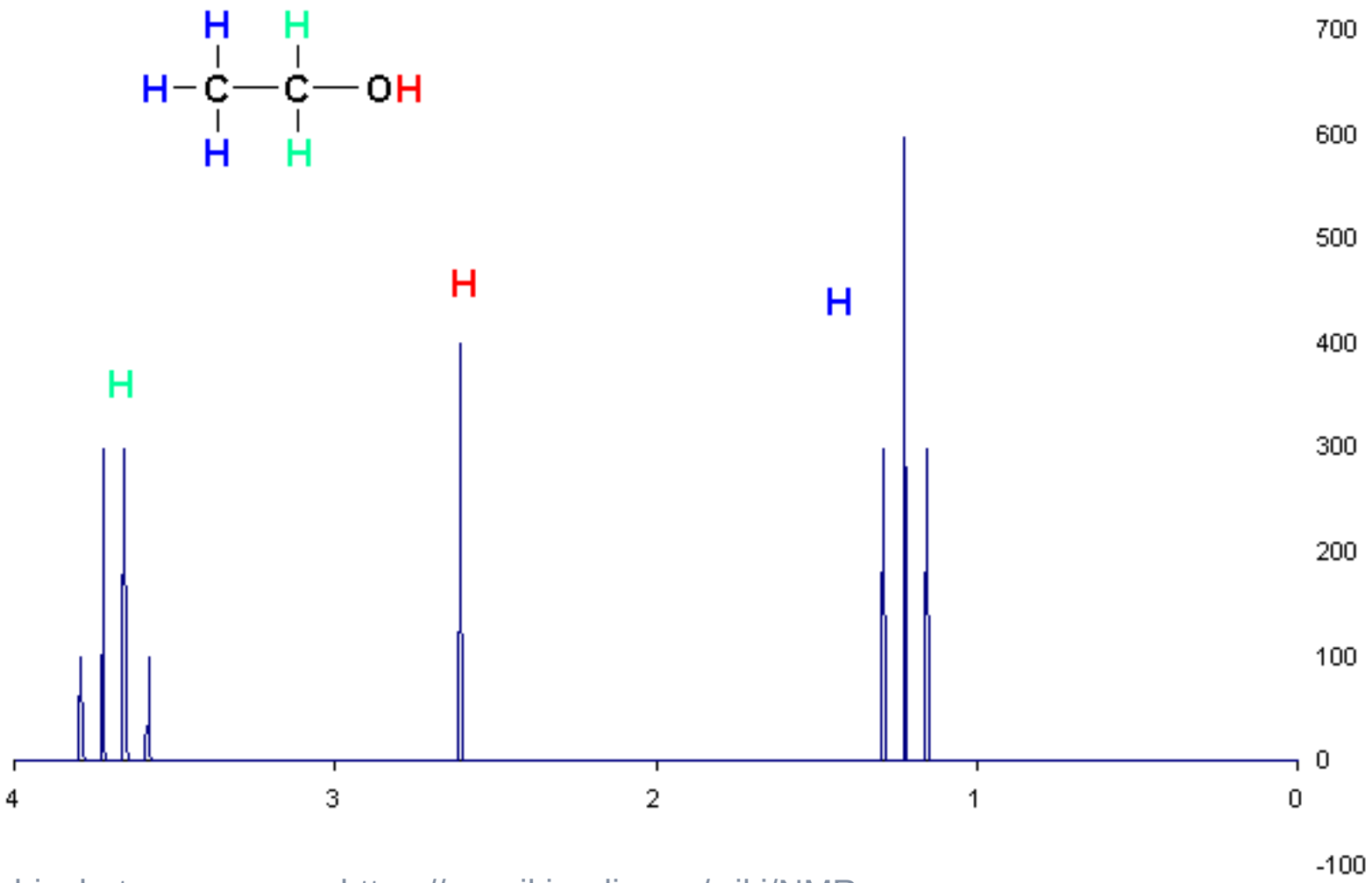


source: chemwiki.ucdavis.edu/

- TLC help visualize progress of reaction
- Column Chromatography purifies the reaction

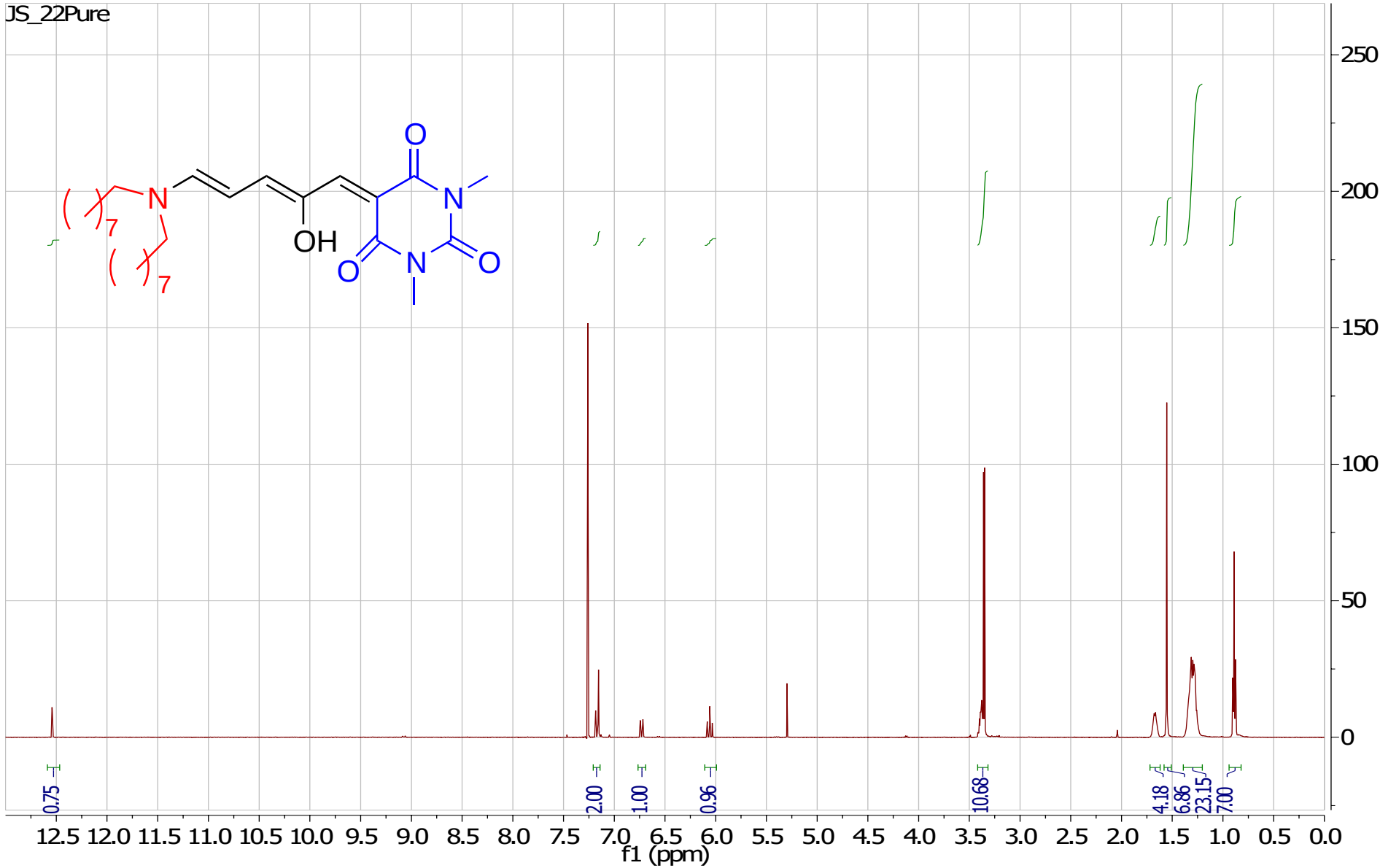
^{1}H-NMR Identifies Compounds

Ethanol

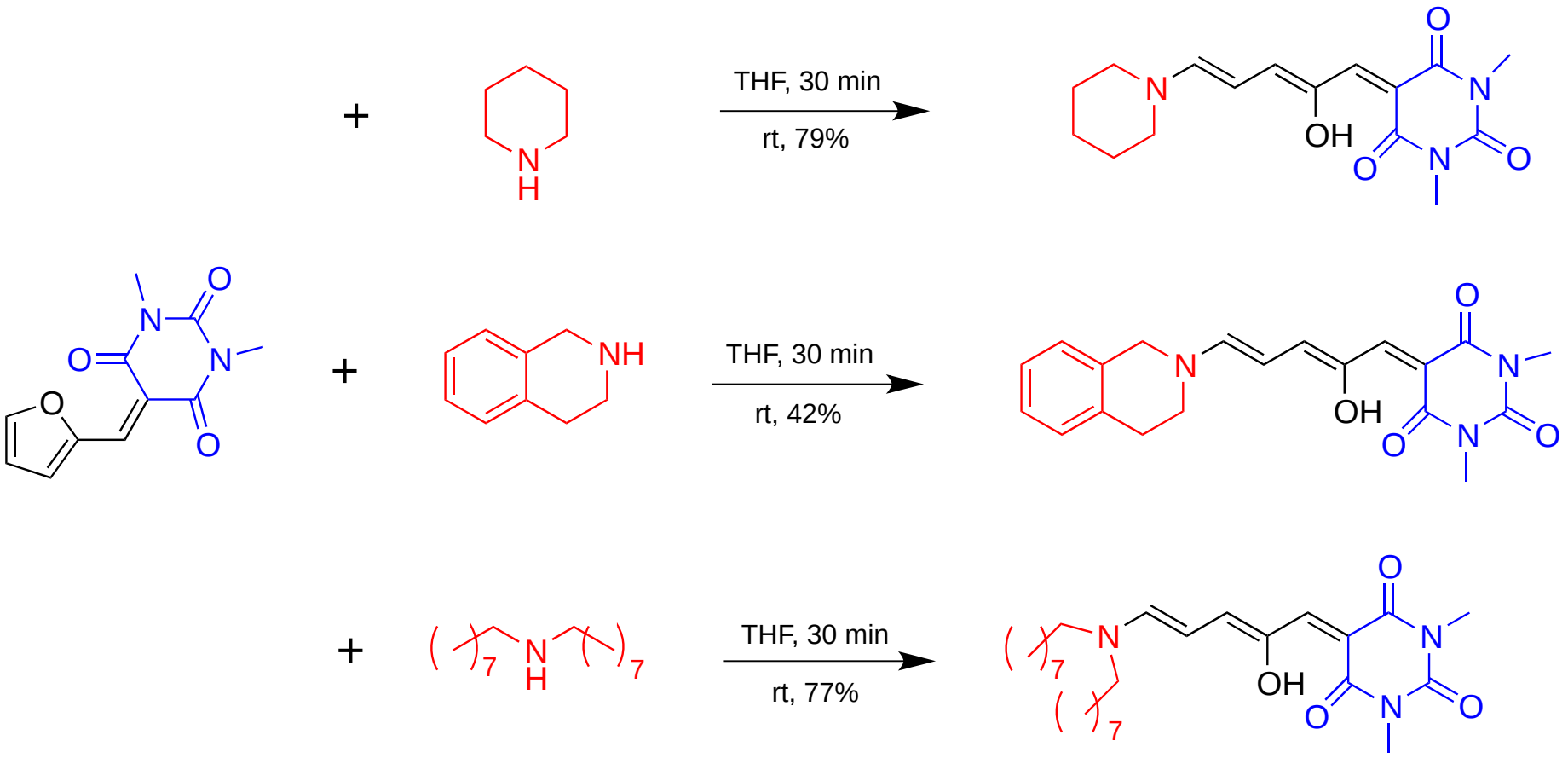


Sources: bigshotcamera.com, https://en.wikipedia.org/wiki/NMR

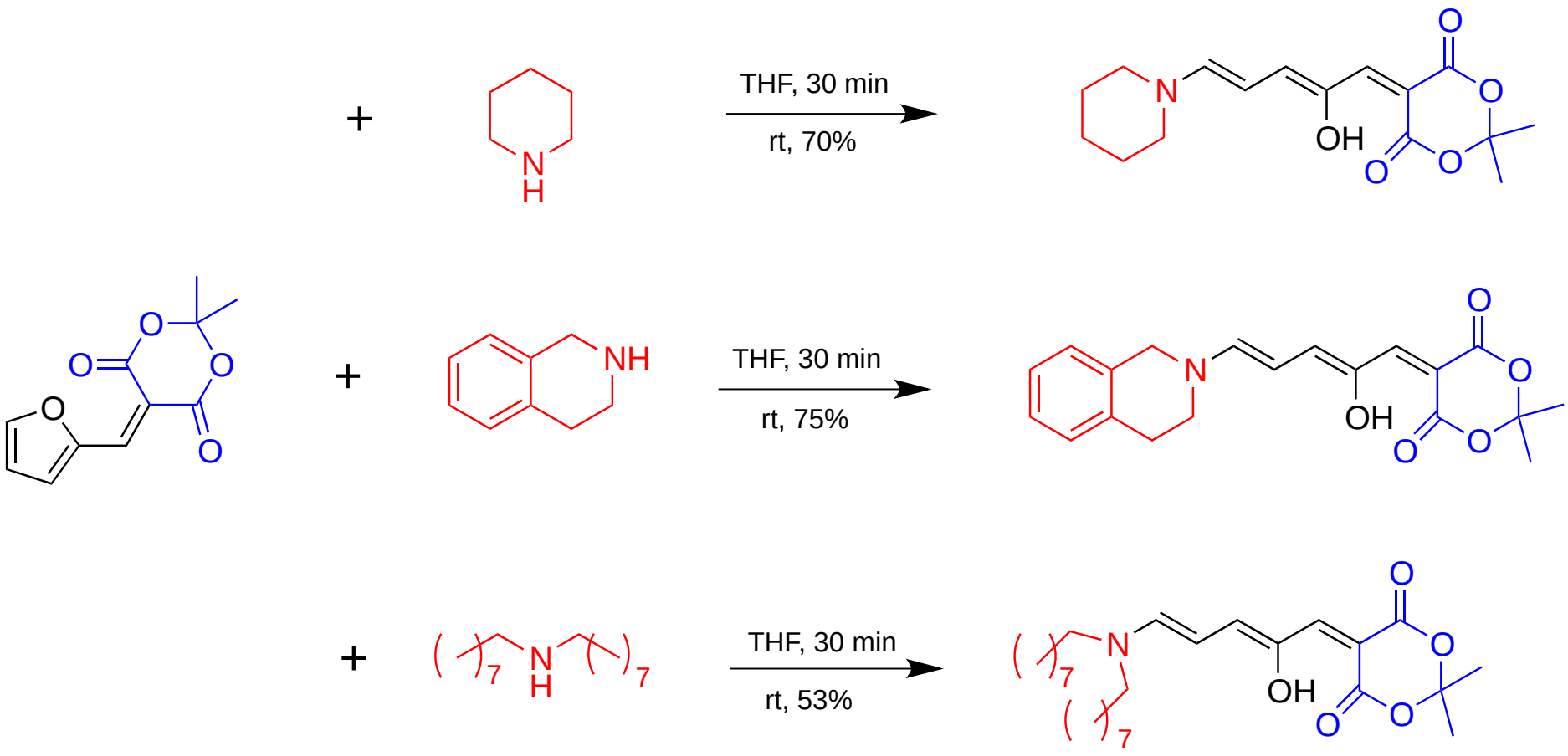
^{1}H-NMR Of Dioctyl Amine Adduct Confirms Purity



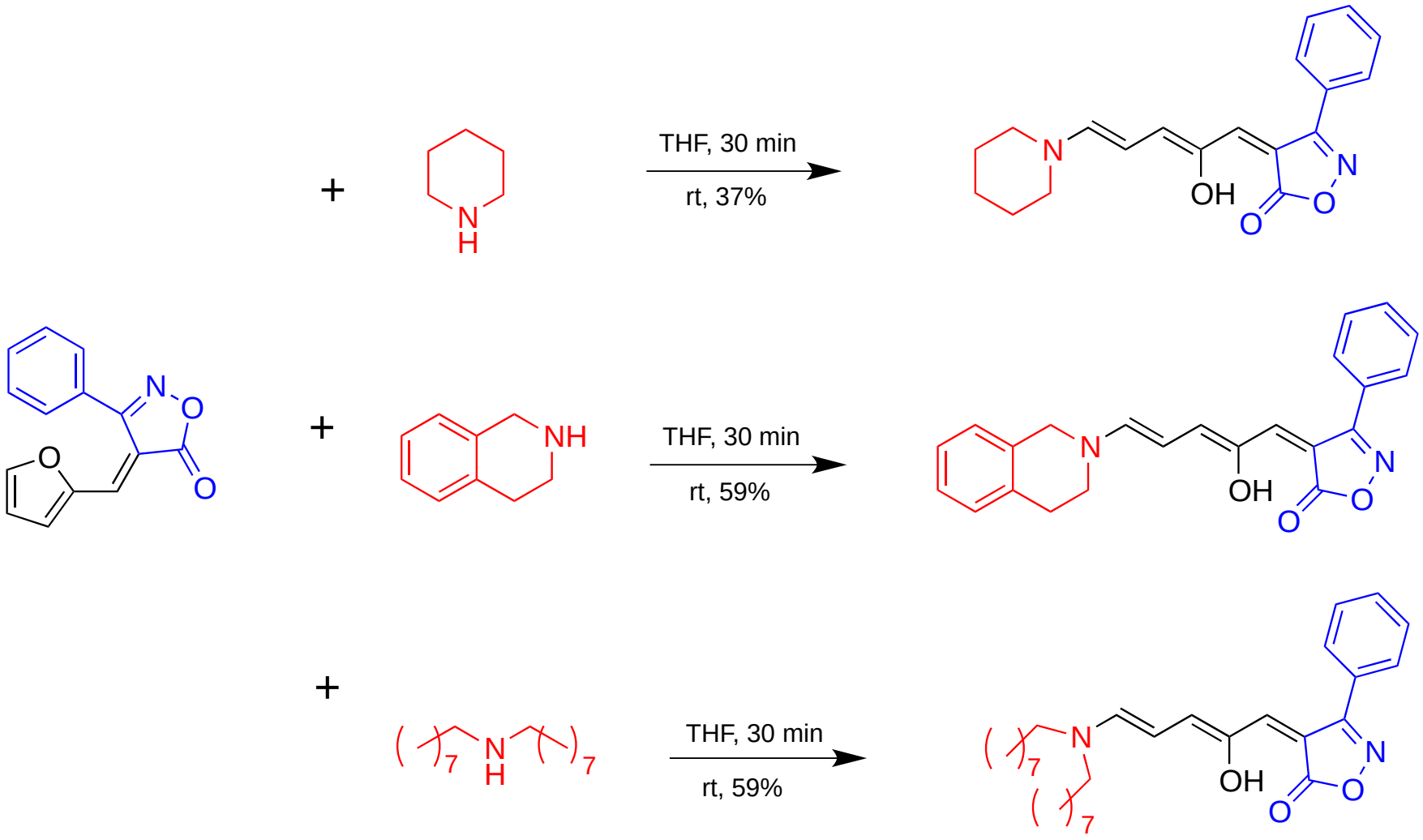
Synthesis Of Barbituric Acid Acceptor With Various Secondary Amines



Meldrums Acid Acceptor Yields Same Results



DASAs With PIO Acceptor Have Slightly Lower Yields



UV/VIS Spectroscopy Measures Absorption

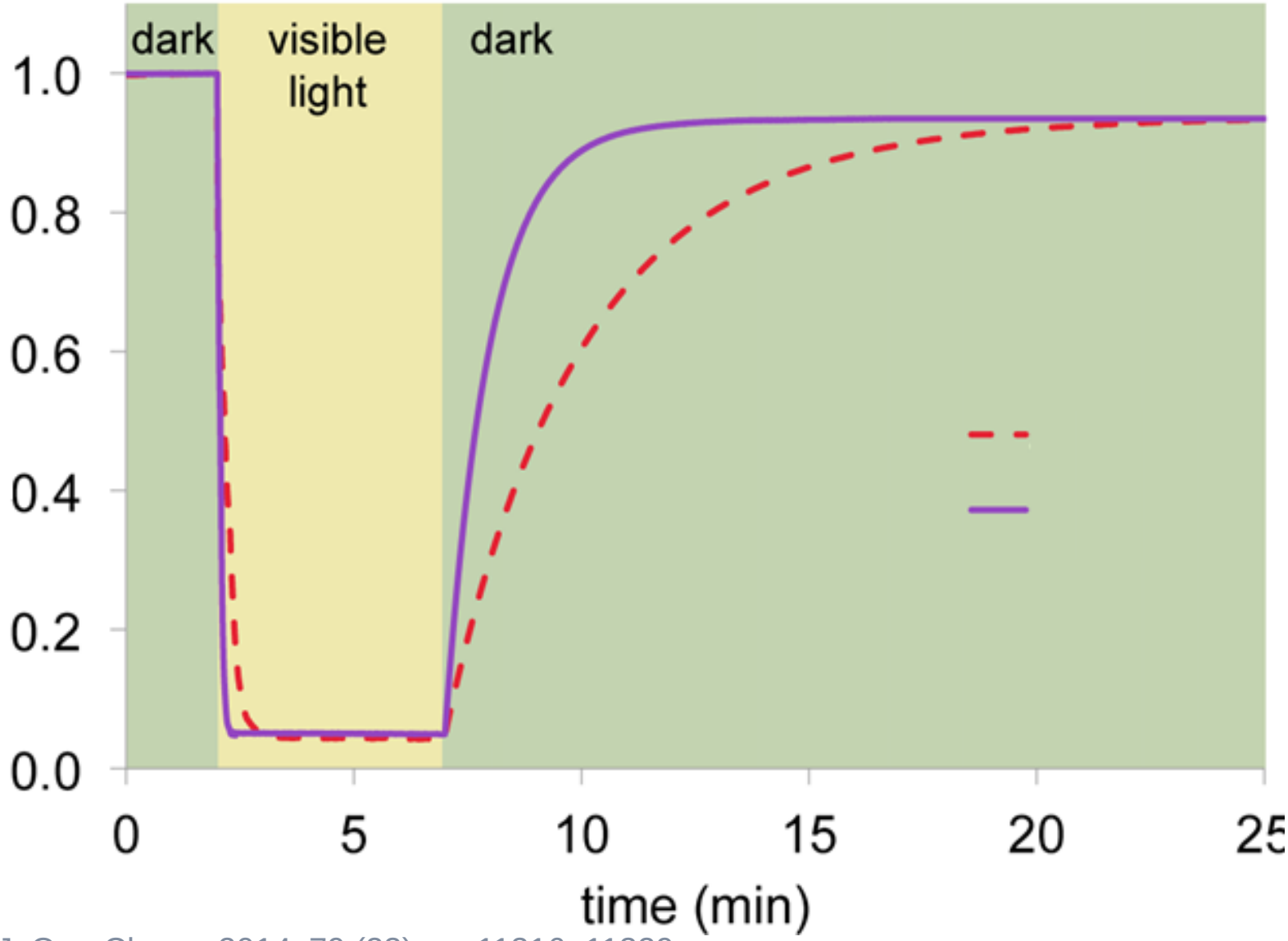
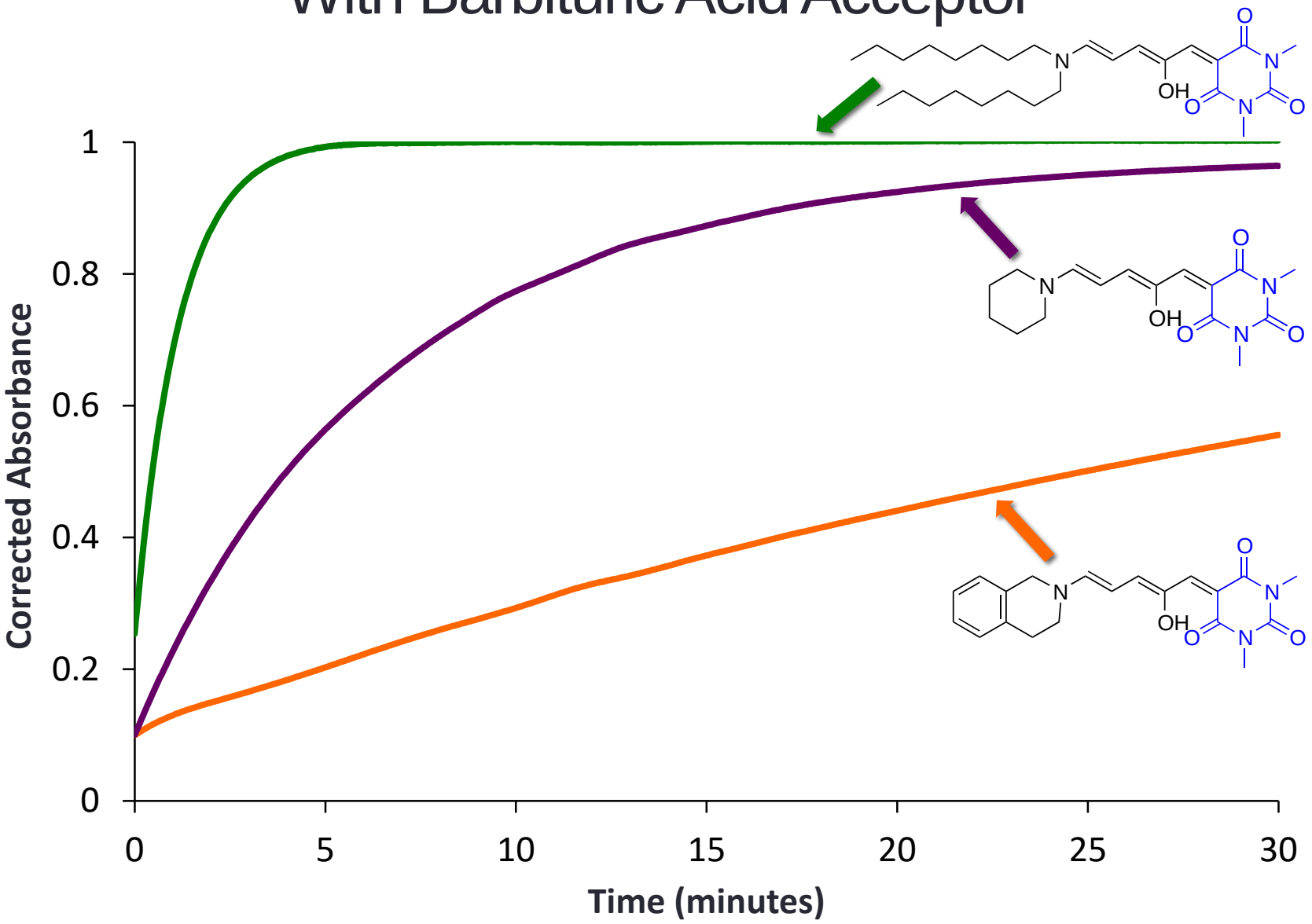
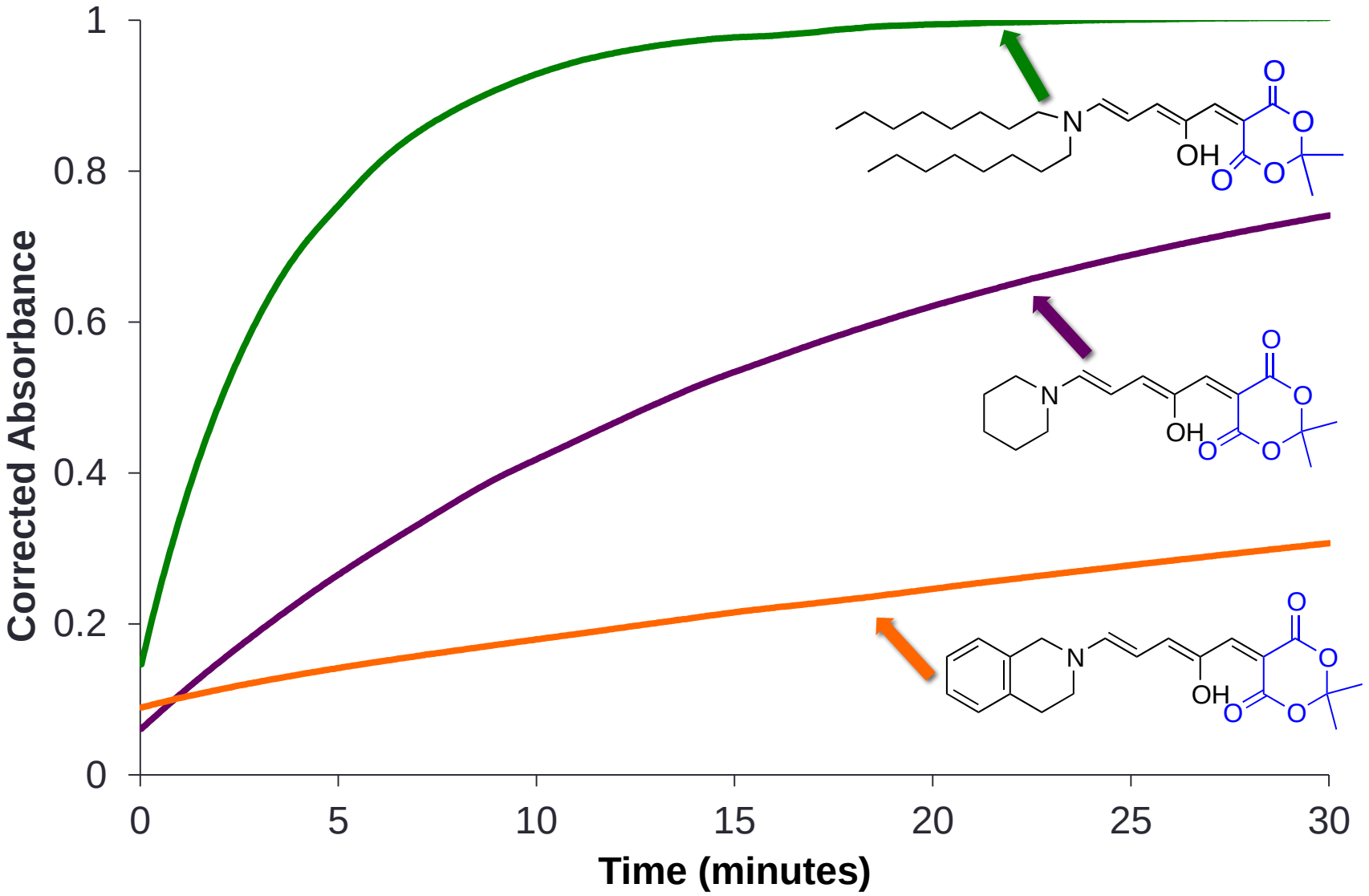


Image: J. Org. Chem., 2014, 79 (23), pp 11316–11329

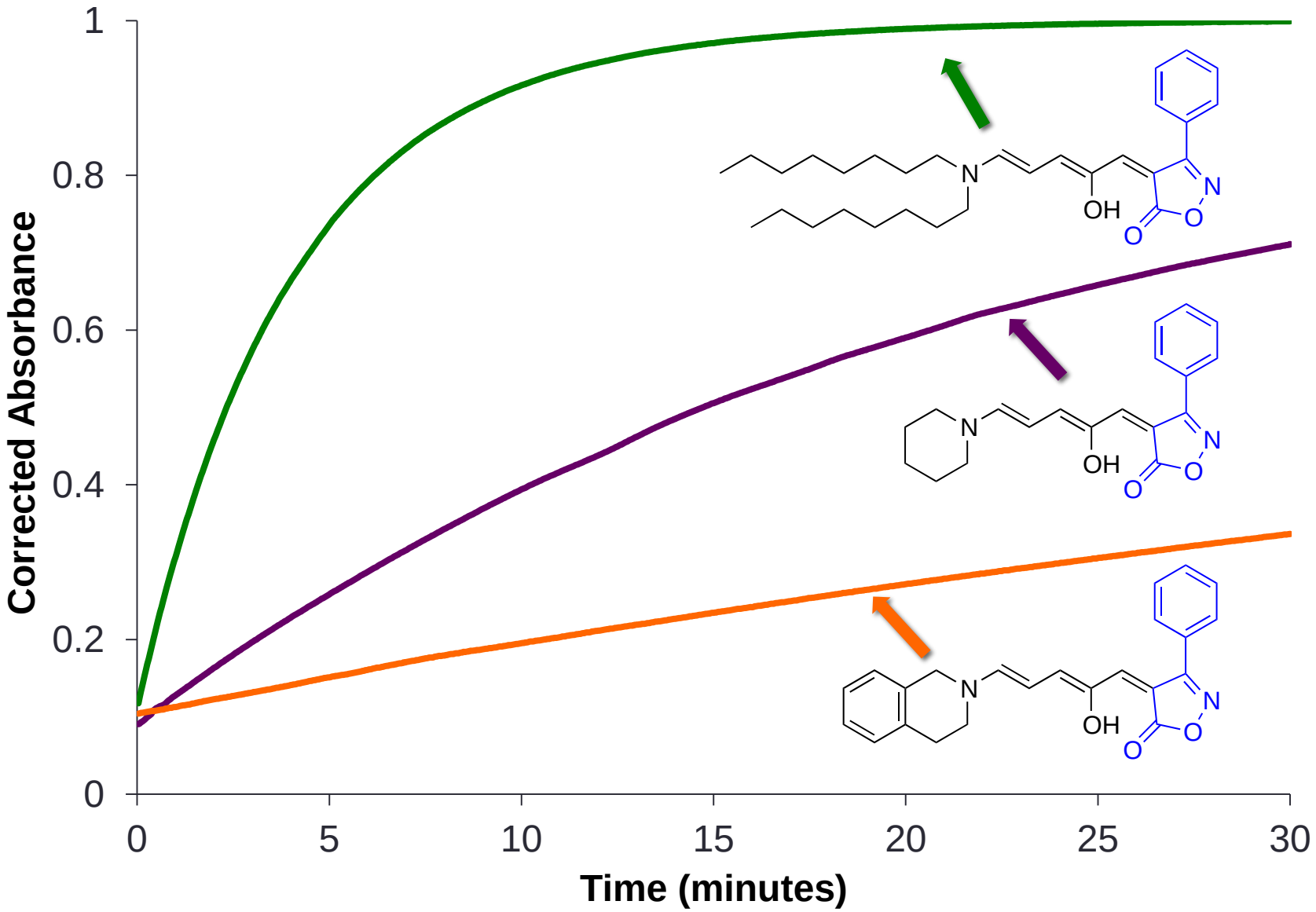
Rate of Conversion From Colorless To Colored With Barbituric Acid Acceptor



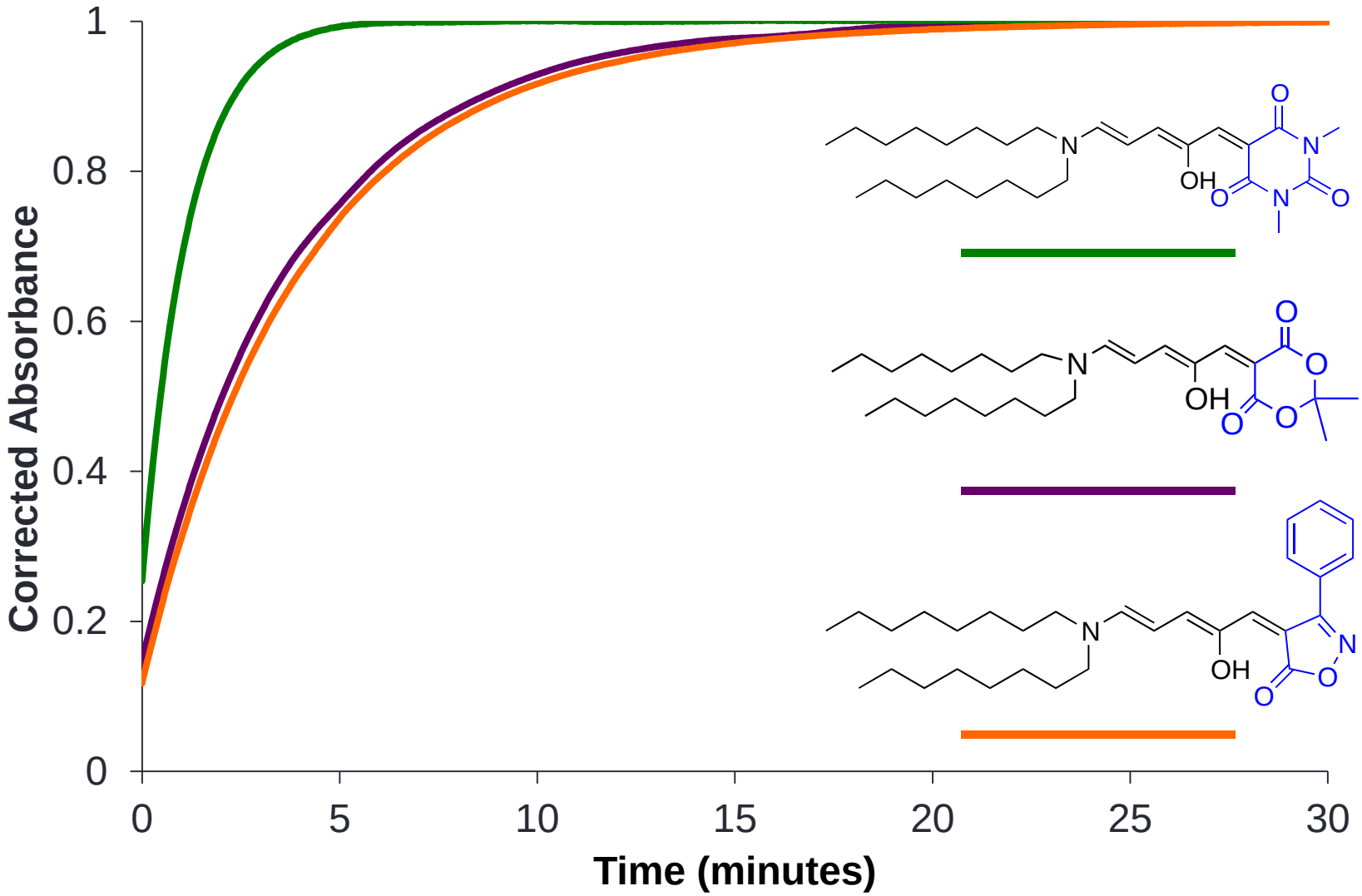
Conversion Is Slower With Meldrums Acid Acceptor



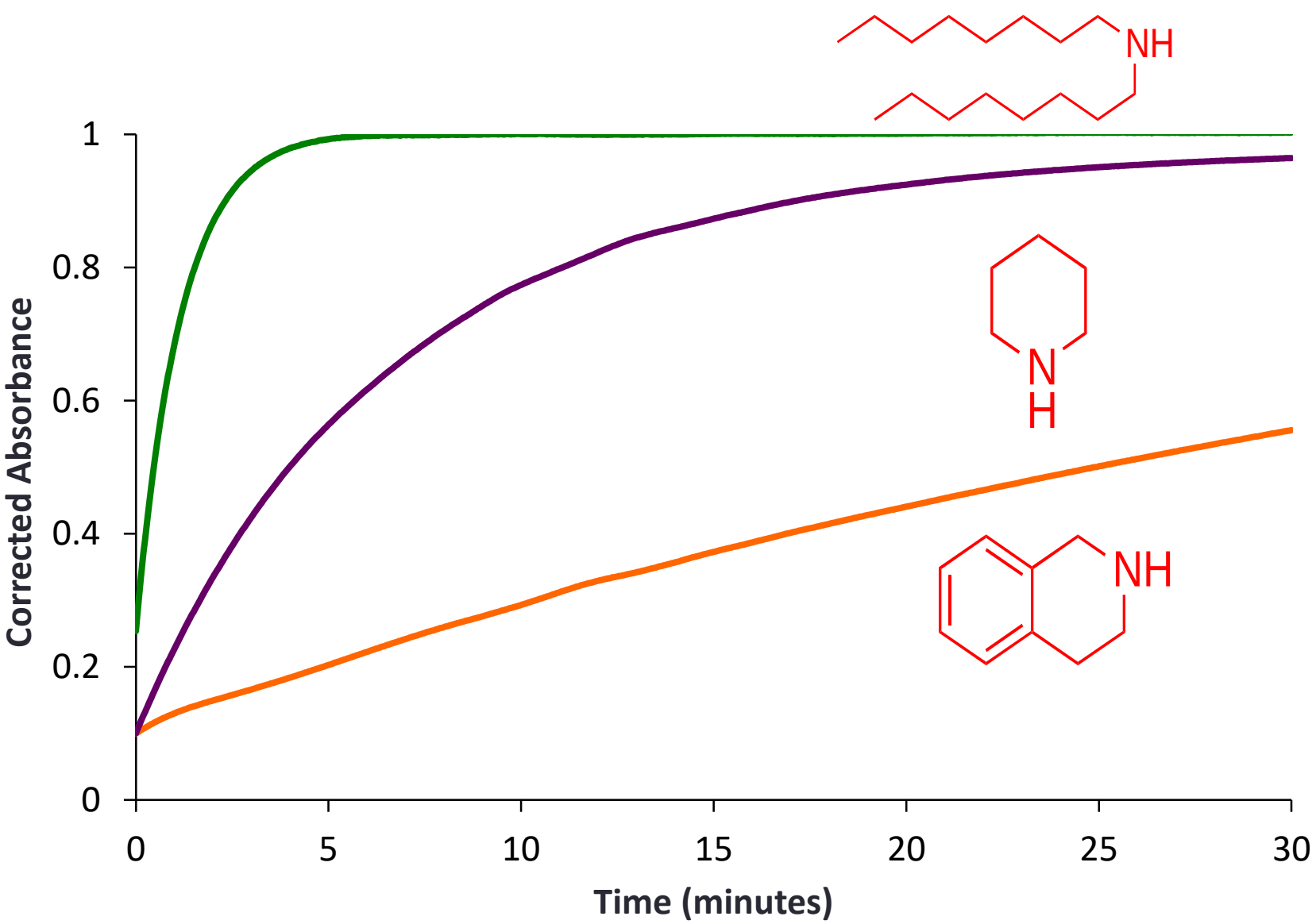
Conversion With PIO Acceptor Similar To Meldrums



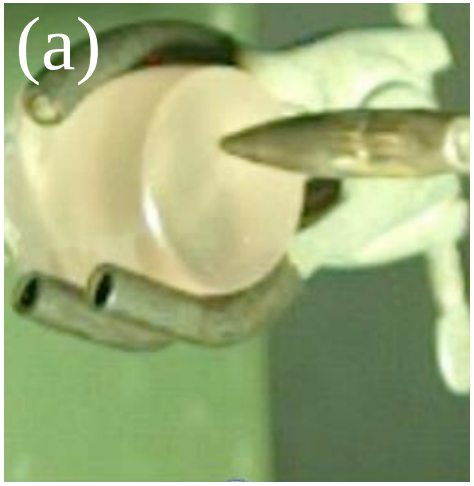
Acceptor Group's Affect On Conversion Rate

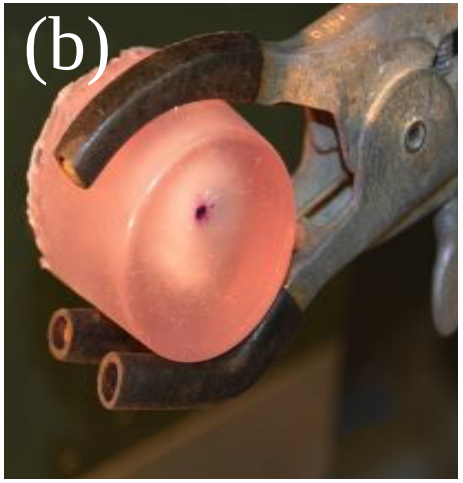


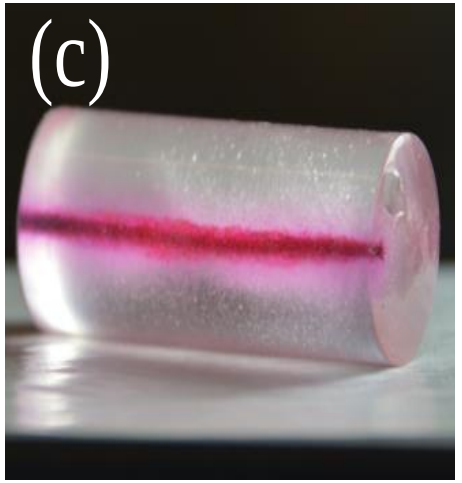
Conclusions And Future Work



Conclusions And Future Work







a) High speed image of projectile prior to impact

b) Image of HTPB sample immediately after impact

c) Projectile trajectory seen by DASA activation

Thank You!!!

- Jimmy Hemmer
- Javier Read de Alaniz
- Entire Lab Group
- Arica Lubin and the MARC program

MARC
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NIH National Institutes of Health

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