SUMITOMO SEIKA CHEMICALS CO.,LTD.

Sulfur – eSSential for Life

SUMITOMO SEIKA

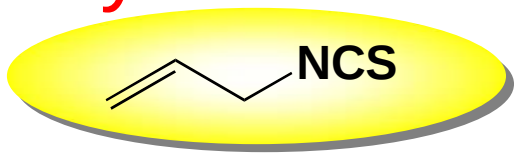
Wasabi

Wasabi

Sushi

- Characteristic heat and flavor
- The heat of real wasabi dissipates quickly

Key Material



Allyl isothiocyanate

and other isothiocyanates

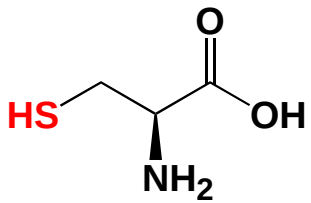
Scientists have started investigating wasabi's isothiocyanates for possible medicinal uses

Content

1. Introduction
2. Structures of sulfur compounds
3. General synthesis of organic sulfur compounds
   - Thiols
   - Sulfides, Sulfoxides, Sulfones
   - Sulfonic acids, Sulfonyl chlorides, Sulfonamides
   - Thiazoles
4. Unique technology of Sumitomo Seika for sulfur compounds
   - Sumitomo Seika’s inorganic sulfur compounds
   - Thiazole technology
   - Sumitomo Seika’s organic sulfur compounds
   - SR technology

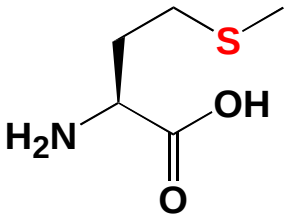
SUMITOMO SEIKA

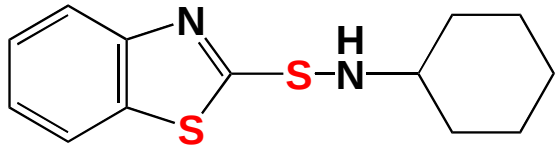
1. Introduction



Cysteine

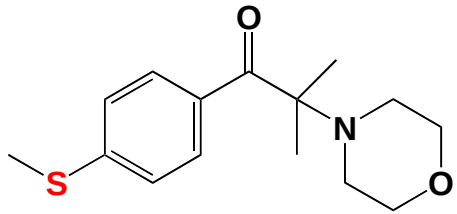
Methionine





ex. CBS

Rubber accelerator

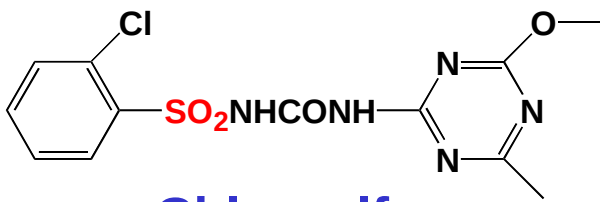


ex. Irgacure 907

Photochemical

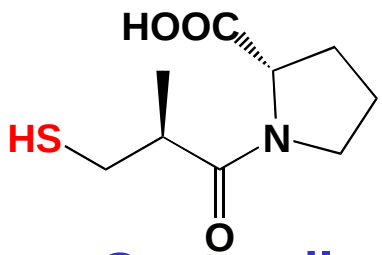
Sulfur - eSSential for life

Agrichemicals



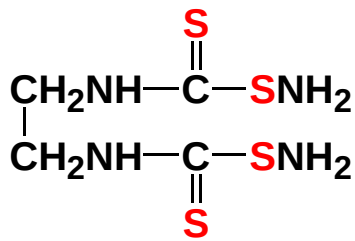
ex. Chlorsulfuron

Pharmaceuticals



ex. Captopril

Fungicide



ex. Amobam

SUMITOMO SEIKA

2. Structures of sulfur compounds

Di-coordination

Thiol

R-SH

Sulfide

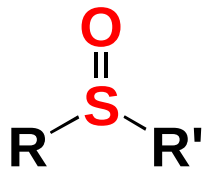
R-S-R'

Disulfide

R-S-S-R'

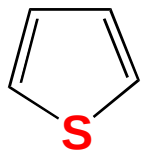
Tetra-coordination

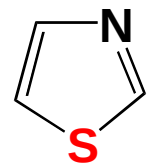
Sulfoxide

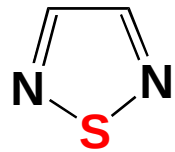


Sulfur compounds

Hetero cycles



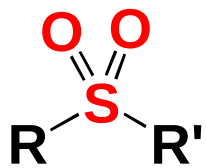




Thiophene

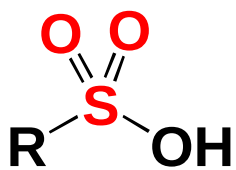
Thiazole

Thiadiazole

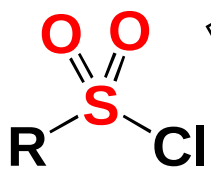


Sulfone

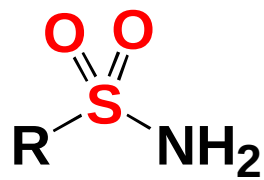
Hexa-coordination



Sulfonic acid



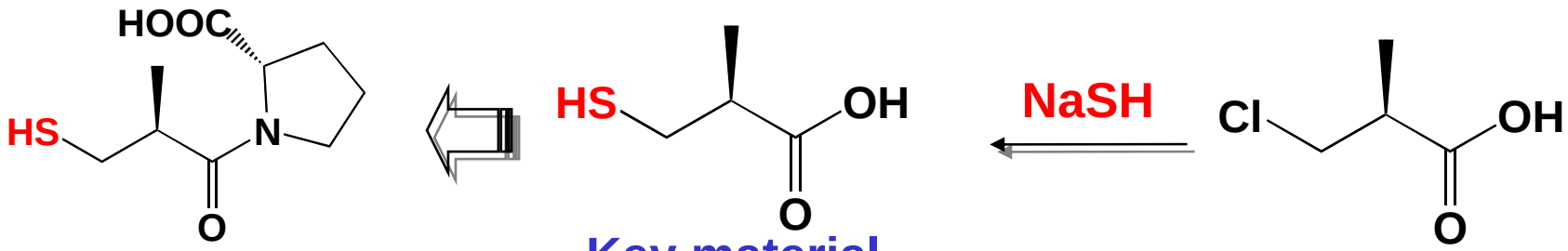
Sulfonyl chloride



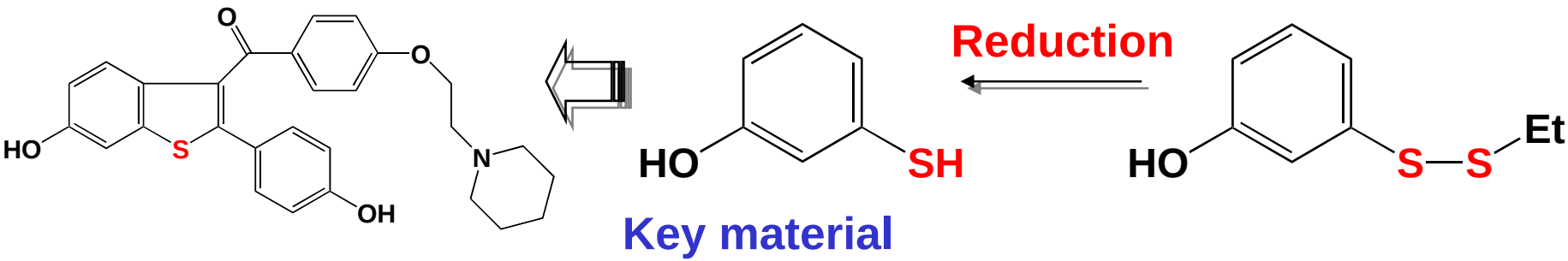
Sulfonamide

3-1. Synthesis of Thiol

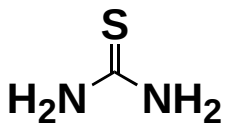
ex.1 Captopril (Anti-Hypertension drug)



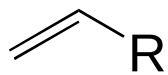
ex.2 Raloxifen (Anti-Osteoporosis drug)



1) Red. of R-S-S-R or R-SO2Cl

2) R-X + NaSH or 

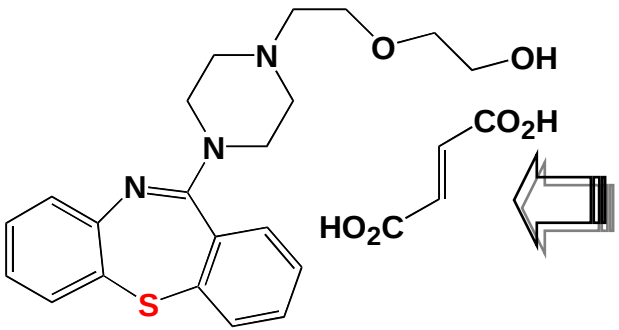
3) R-MgX + S_8

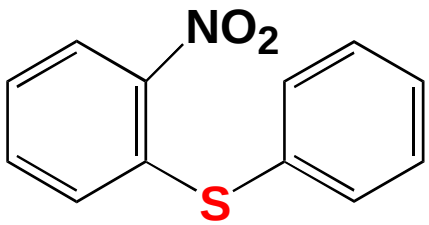
4) 

+ H_2S

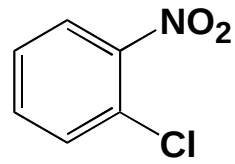
3-2. Synthesis of Sulfides, Sulfoxides, and Sulfones

ex.1 Quetiapine fumarate (Anti-schizophrenia drug)

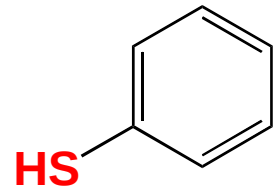




Key material



Base

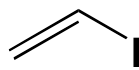


1) R-X + Na_2S

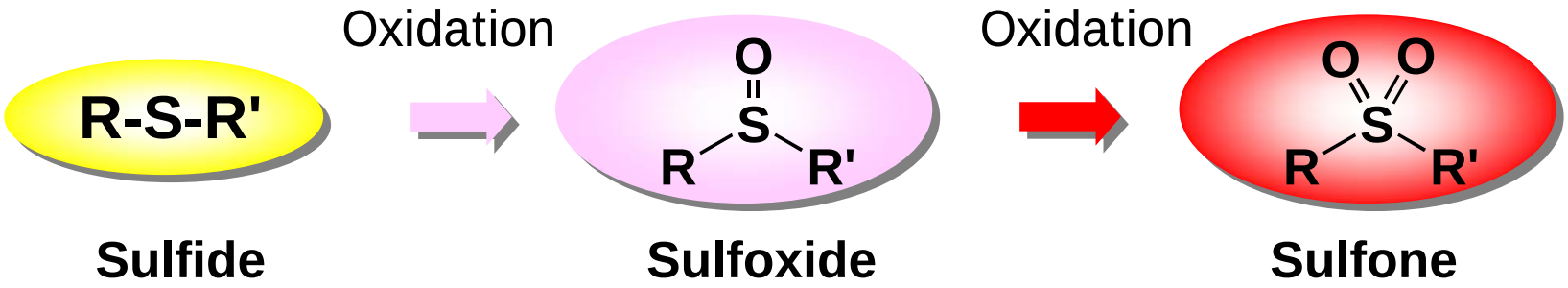
2) R-X + NaSR'

R-S-R'

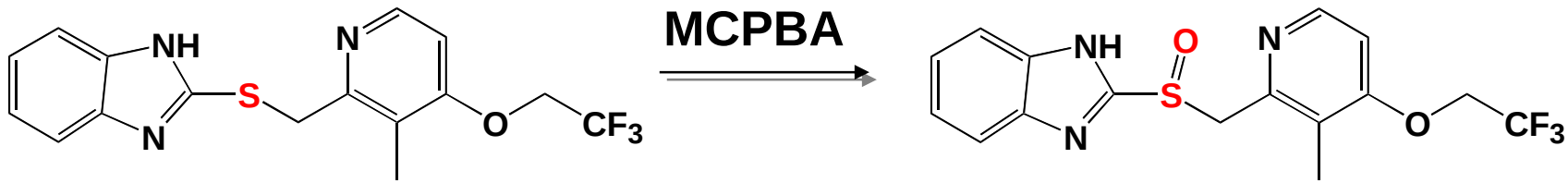
3) Aryl compound + SCl_2

4)  + R'-SH

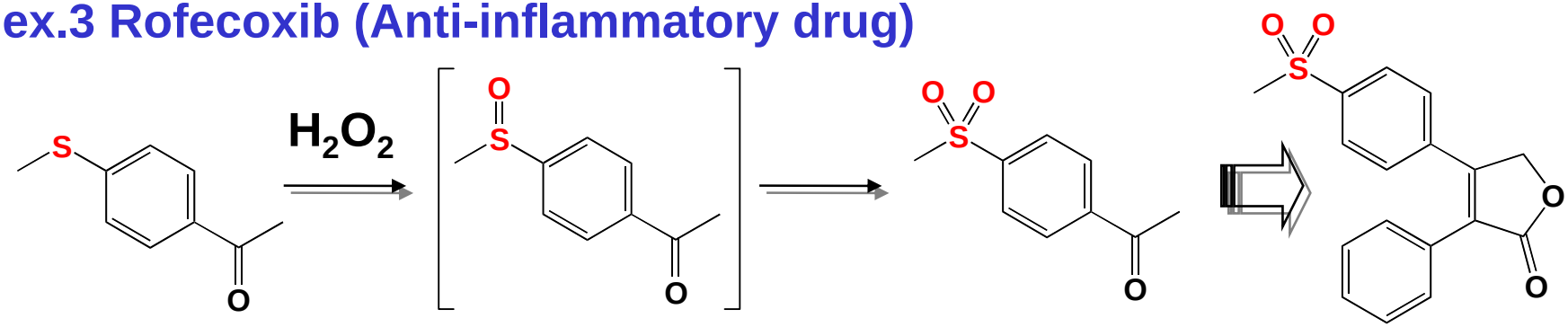
3-2. Synthesis of Sulfides, Sulfoxides, and Sulfones



ex.2 Lansoprazole (Anti-ulcer drug)

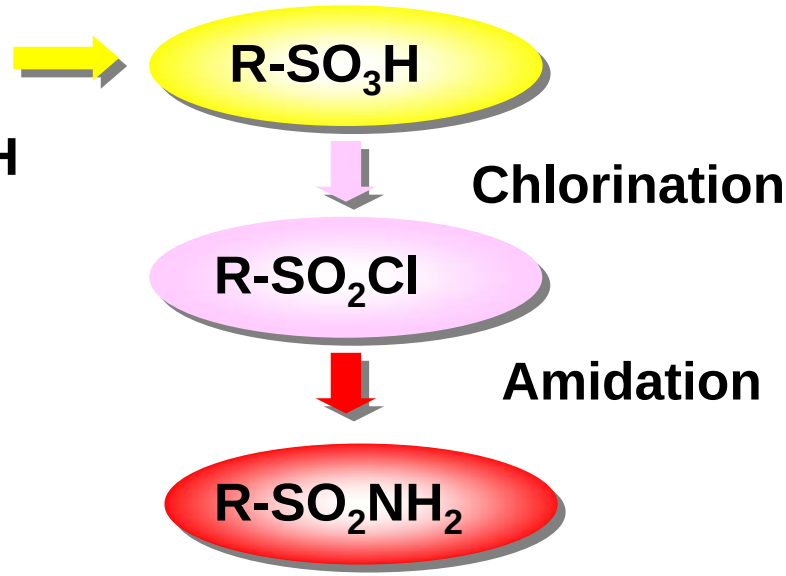


ex.3 Rofecoxib (Anti-inflammatory drug)

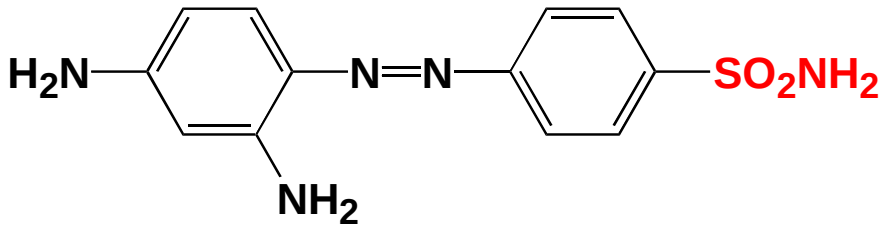


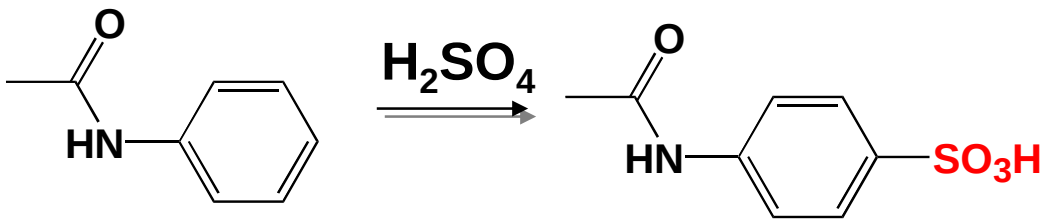
3-3. Synthesis of Sulfonic acids, Sulfonyl chlorides and Sulfonamides

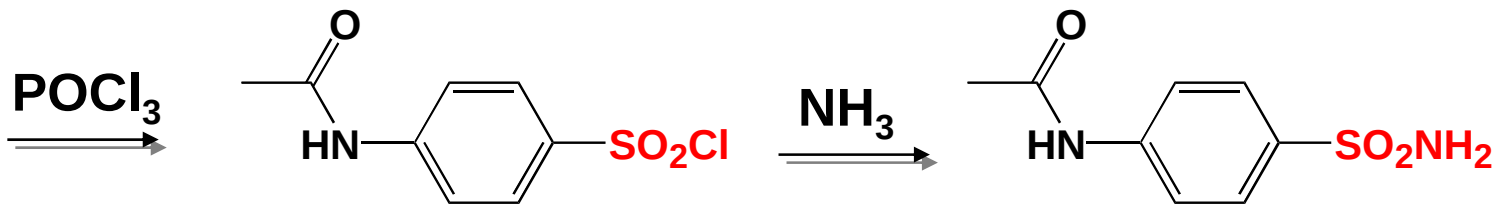
1) R-X + Na_2SO_3
2) Oxidation of R-SH
3) Aryl compound + H_2SO_4 or $ClSO_3H$



ex.1 Prontosil (Sulfa-drug antibiotics)



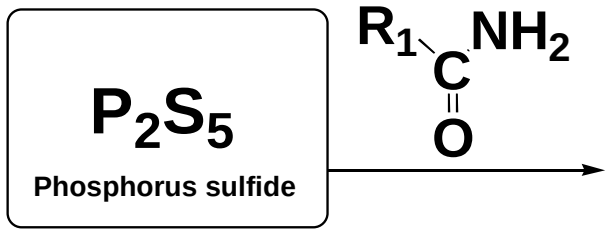




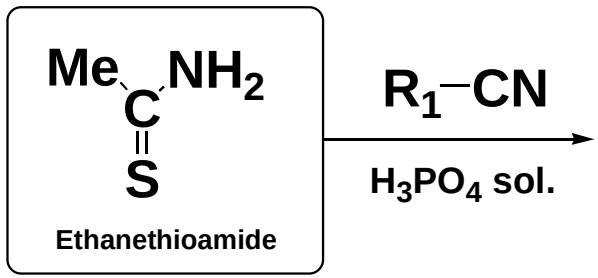
Key material

3-4. Synthesis of Thiazoles

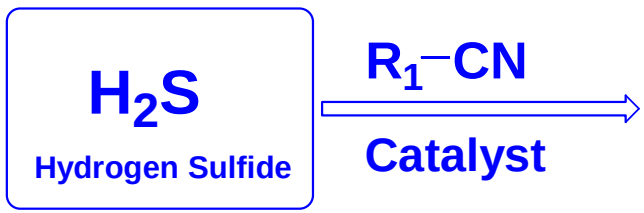
1) Phosphorus pentasulfide method

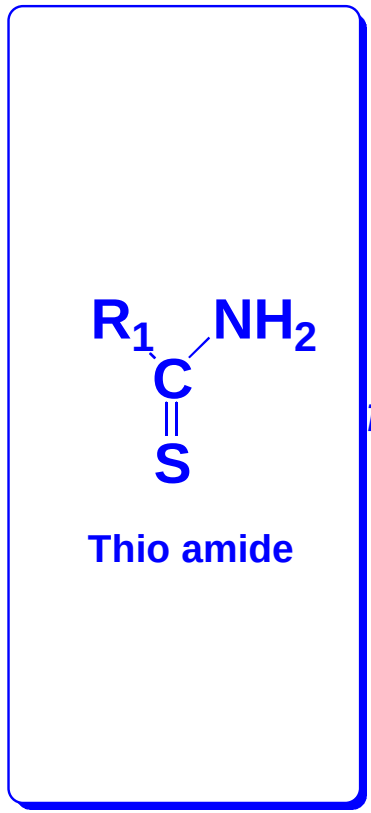


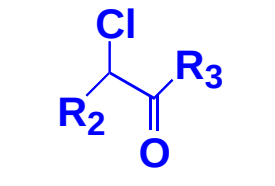
2) Thioamide method

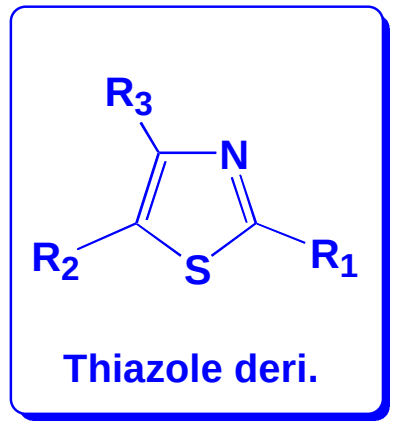


3) Hydrogen sulfide method



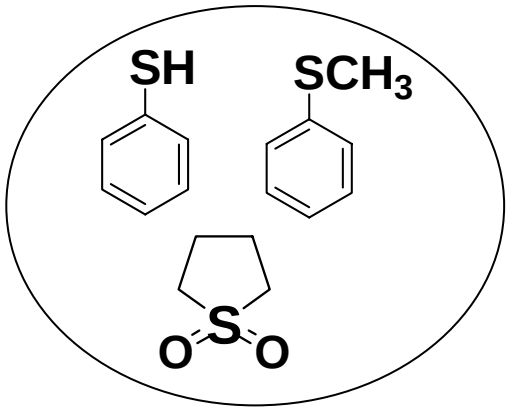






□H2S method□
1. High yield
2.High purity
3.No Phosphorus waste water

4. Sumitomo Seika's Inorganic sulfur products



Organic sulfur products

Commercial Products

$SOCl_2$

S_2Cl_2

SO_2Cl_2

SO_2

H_2S

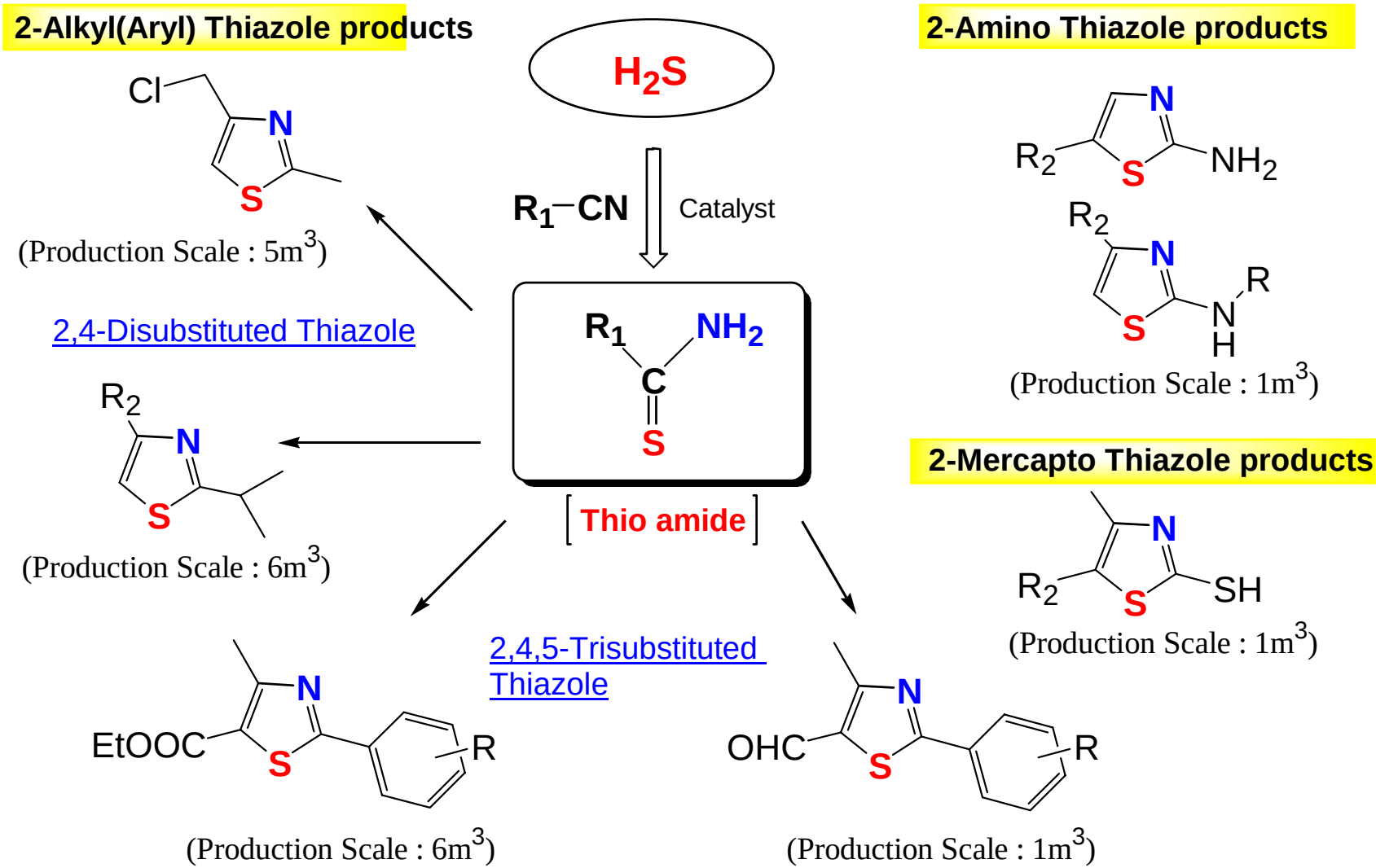
Seika's commercial products

S

H2S (Hydrogen sulfide)
- **Poisonous gas**
  tolerable level: 10ppm
- **Pungent odor**
- **High reactivity**

Sumitomo Seika uses H_2S as key raw material to produce complex sulfur intermediates

4-1. Thiazole technology



4-2. Sulfur products of Sumitomo Seika

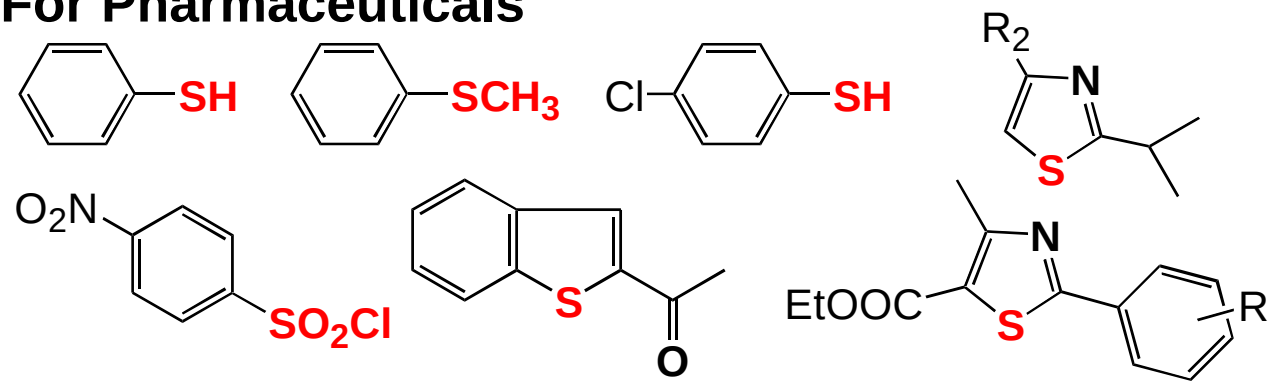
1) Inorganic sulfur products

H_2S SO_2 S_2Cl_2 $SOCl_2$ SO_2Cl_2

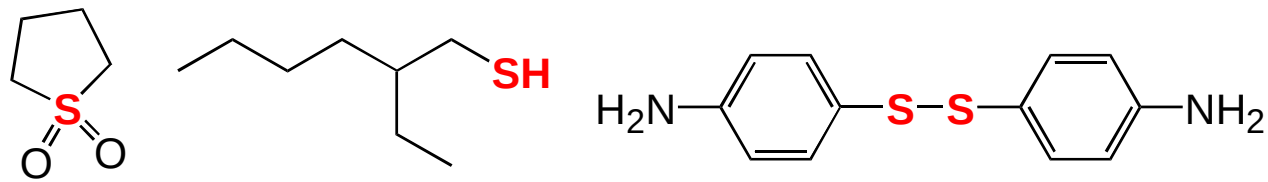
These basic products are used production of organic sulfur products.

2) Organic sulfur products

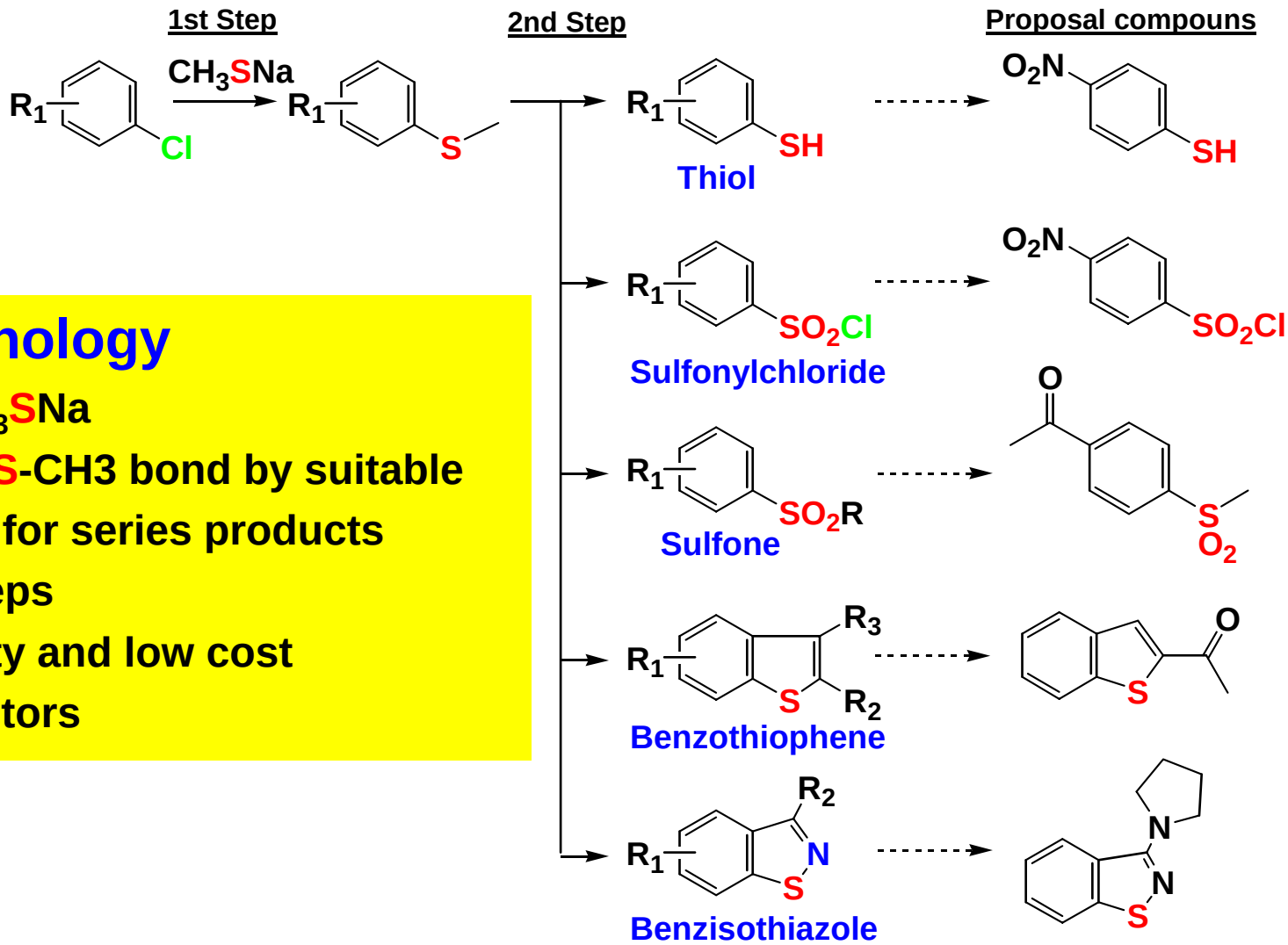
For Pharmaceuticals



For Functional chemicals



4-3. SR Technology



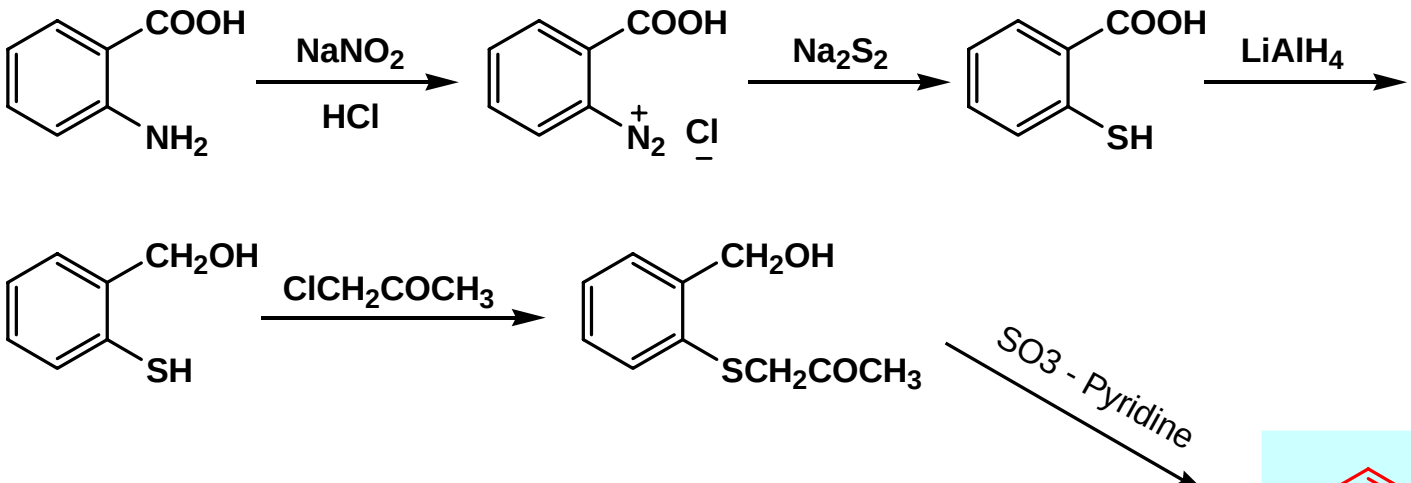
SR technology

- Using CH_3SNa
- Cleaving S-CH3 bond by suitable condition for series products
- Only 2 steps
- High purity and low cost
- 20m³ reactors

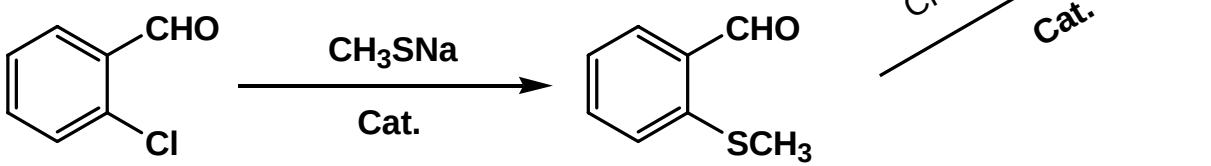
4-3. SR technology

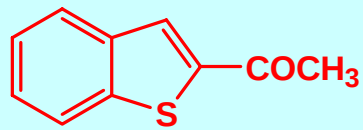
ex. 2-Acetyl benzothiophene

Old reaction □5Step□



SR reaction □Only 2 Step□

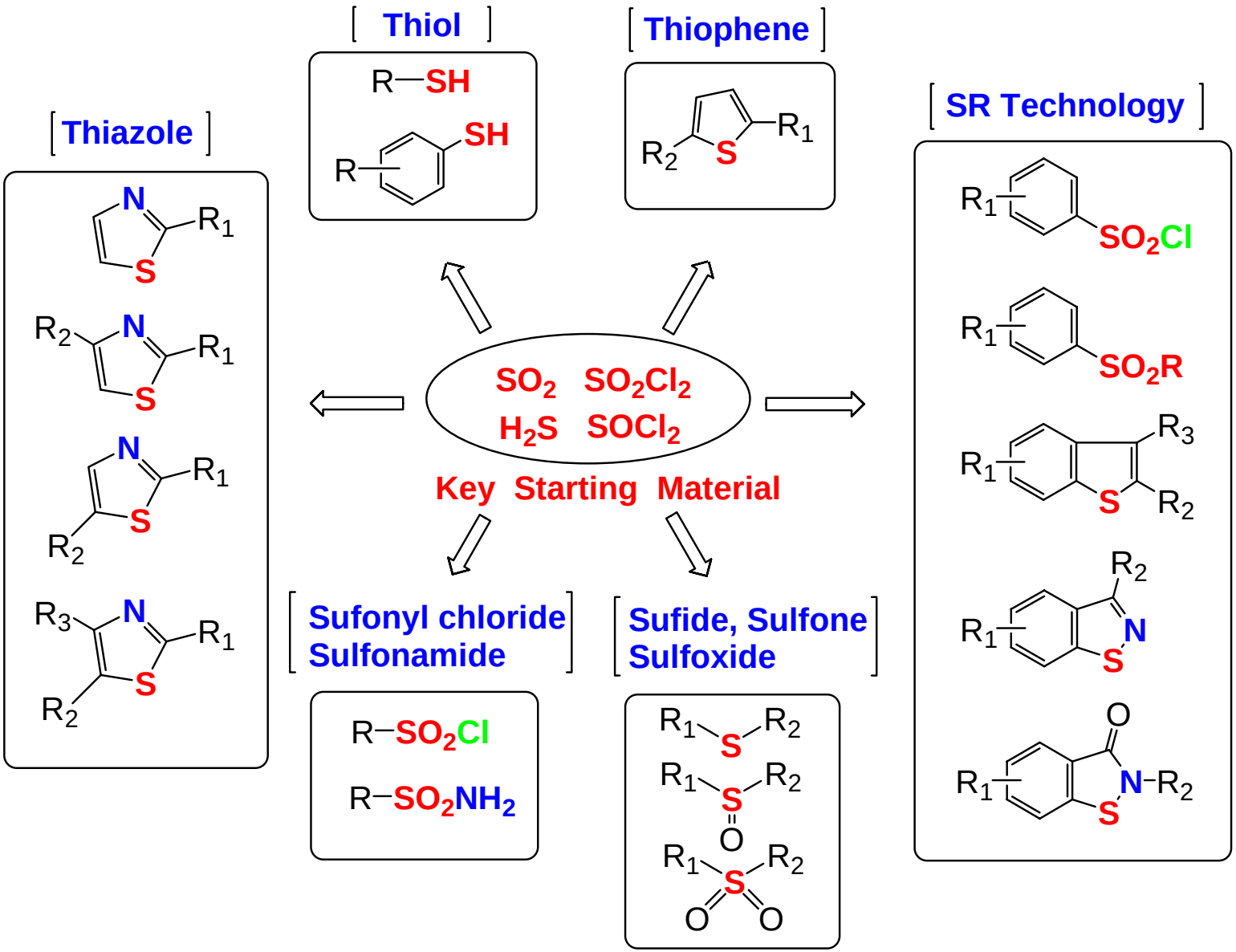




Acetyl Benzo thiophene

SUMITOMO SEIKA

4-5. Summary of Sumitomo Seika's sulfur products



SUMITOMO SEIKA

Thank you very much

Sumitomo Seika Sulfur

Sulfur - eSSential for Life