



ID	31182	Status	Dato
Risikoområde	Risikovurdering: Helse, miljø og sikkerhet (HMS)	Opprettet	30.01.2019
Opprettet av	Kristiane Søvde Oftebro	Vurdering startet	30.01.2019
Ansvarlig	Kristiane Søvde Oftebro	Tiltak besluttet	
		Avsluttet	

Risikovurdering:**CAT, Master student, 2019, Kristiane Søvde Oftebro****Gyldig i perioden:**

9/3/2018 - 6/30/2019

Sted:

Kjemiblokk 5, Kjemiblokk 2 og Nanolab (kjemiblokk 1)

Mål / hensikt

This risk assessment contains all the activities that Kristiane Søvde Oftebro will perform in different laboratories. She will synthesise and characterize BiO and Bi₂O₂CO₃ nanoparticles, with the purpose of use as photocatalysts in the ammonia synthesis. The Bi₂O₂CO₃ particles will also be deposited with Au nanoparticles to tune the bandgap of the particles, and heat treated to undergo thermal decomposition

Bakgrunn

The Bi-nanoparticles are expected to work as photocatalysts in the ammonia synthesis, and N₂ reduction to ammonia by solar light represents a green and sustainable ammonia synthesis approach which help reduce the energy consumption compared to the standard Haber-Bosch process. It will also eliminate the emission of CO₂ compared to today's process.

Bi₂O₂CO₃ (BSC) will be synthesized through a hydrothermal method in lab K5-317, the furnace in Kjemihall D will be used for heat-treatment (180C), the centrifuge in lab K5-228 and vacuum oven in lab K5-215 will also be used. Gold will be deposited onto BSC particles through both chemical bath deposition and photodeposition methods. For the photodeposition method argon gas will be used for purging (99.999% purity, 64% opening) and a solar lamp of 150 W in lab K5-317. Chemicals that will be used: Bismuth (III) nitrate pentahydrate, Sodium citrate dihydrate, urea, sodium hydroxid, Palladium (II) chloride, hydrochloric acid, gold chloride, sodium sulfite, EDTA, Potassium dihydrogen phosphate, hydrazine monohydrate, ethanol, distilled water. A second method of Bi₂O₂CO₃ synthesis will also be performed to synthesise a flower structure. In addition to the chemicals above, Polyvinylpyrrolidone (PVP) will be used. Otherwise the procedure is similar in terms of risk assessment.

BiO will be synthesized through a hydrothermal method in lab K5-317, the furnace in Kjemihall D will be used for heat-treatment (140C), the centrifuge in lab K5-228 and freeze dryer in lab K5-315 will also be used. Chemicals that will be used: Sodium Oleate, Bismuth (III) nitrate pentahydrate and ethanol (96%).

The photocatalytic activity for ammonia production of BSC and BiO will be tested in lab K5-317 using a solar lamp of 150 W as the radiation source. The photocatalyst sample dispersed in water will be purged with nitrogen gas at ambient conditions before radiation. UV-vis spectrophotometer (in lab 315) will be used for detection of concentration, by using Nessler's Reagent. Nessler's Reagent and NH₄Cl will be used to make a calibration curve for ammonia concentration.

Equipment and instruments that will/might be used: SEM Apreo (Nanolab), XRD (K2-113), BET (K5-425), TGA (K5-441), UV-vis (K5-317, K5-315), High temperature furnaces (Kjemihall D), EDX (Nanolab), centrifuge (K5-228), vacuum oven (K5-215), sonication bath (K5-317), autoclaves, XRF (K5-425), freeze dryer (K5-315).

Beskrivelse og avgrensninger

The risk assessment is limited to the lab work involving risk, which means the synthesis of the particles, the powder characterization by using techniques such as BET, XRD, ICP-MS, SEM, TGA, UV-vis and EDX, and catalytic tests that will be performed in the laboratories of the Catalysis Group, using a photocatalytic set-up and a solar simulator. A freeze drying instrument and UV-vis will also be used, and these instruments are in laboratory K5-315 (Ugelstad laboratory).

The catalysts will be produced by a hydrothermal synthesis, using temperatures from 140-180C.

Forutsetninger, antakelser og forenklinger

The work assumes that proper training is given prior to the use of laboratories and equipment/instruments, to minimize the probability of user-caused mistakes. Safe storage and handling of samples between labs are crucial.

**Vedlegg**

Bismuth (III) nitrate pentahydrate_english.pdf
NaOH.pdf
PdCl2.pdf
Potassium phosphate monobasic.pdf
SDS_esslersreagent_english.pdf
sodium citrate dihydrate_english.pdf
sodium oleate_english.pdf
Sodium sulfite_english.pdf
urea_english.pdf
Ethanol.pdf
EDTA.english.pdf
Hydrazinmonohydrat_english.pdf
Hcl_english.pdf
Gold(III) chloride hydrate_english.pdf
Confirmation_Laboratory work after normal working hours_KristianeOftebro.pdf
NH4OH_english.pdf

Referanser

[Ingen registreringer]



Oppsummering, resultat og endelig vurdering

I oppsummeringen presenteres en oversikt over farer og uønskede hendelser, samt resultat for det enkelte konsekvensområdet.

Farekilde: Hydrothermal synthesis of BiO nanoparticles in lab K5-317

Uønsket hendelse: Exposure to and inhalation of dust from sodium oleate

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to and inhalation of bismuth (III) nitrate pentahydrate


Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Ytre miljø


Risiko før tiltak:  Risiko etter tiltak: 

Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to Ethanol

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Ytre miljø

Risiko før tiltak:  Risiko etter tiltak: 

Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 

Farekilde: Hydrothermal preparation of Bi₂O₂CO₃ nanodisks in lab K5-317.

Uønsket hendelse: Exposure to and inhalation of bismuth (III) nitrate pentahydrate

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Ytre miljø

Risiko før tiltak:  Risiko etter tiltak: 

Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to Sodium Hydroxid

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to sodium citrate hydrate

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to ethanol

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 




Farekilde: Hydrothermal preparation of Bi₂O₂CO₃ nanodisks in lab K5-317.

Uønsket hendelse: Exposure to ethanol

Ytre miljø

Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to and inhalation of dust from urea

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to polyvinylpyrrolidone (PVP)

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Farekilde: Chemical bath deposition of AU nanoparticles onto the Bi₂O₂CO₃ nanodisks in lab K5-317

Uønsket hendelse: Exposure to HCl

Konsekvensområde: Helse

Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to Sodium hydroxide

Konsekvensområde: Helse

Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to Gold(III) chloride hydrate

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Sodium sulfite in contact with acids

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to EDTA

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 



Farekilde: Chemical bath deposition of AU nanoparticles onto the Bi₂O₂CO₃ nanodisks in lab K5-317

Uønsket hendelse: Exposure to Potassium phosphate monobasic

Konsekvensområde: Helse Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to and inhalation of Hydrazine monohydrate

Konsekvensområde: Helse Risiko før tiltak:  Risiko etter tiltak: 
Ytre miljø Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to Palladium (II) chloride

Konsekvensområde: Helse Risiko før tiltak:  Risiko etter tiltak: 


Farekilde: Use of furnaces (Kjemihall D) and vacuum oven (K5-215)

Uønsket hendelse: Accidentally touching a hot surface on the furnace may cause burns

Konsekvensområde: Helse Risiko før tiltak:  Risiko etter tiltak: 

Farekilde: Characterization of powder

Uønsket hendelse: High voltages in SEM, EDX (Nanolab, kjemiblokk 1)

Konsekvensområde: Helse Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Handling of nanoparticles for sample preparation for SEM, XRD (Nanolab and K2-113)

Konsekvensområde: Helse Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Hot surfaces (K5-441)

Konsekvensområde: Helse Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: X-ray radiation (K2-113)

Konsekvensområde: Helse Risiko før tiltak:  Risiko etter tiltak: 



Farekilde: Characterization of powder

Uønsket hendelse: Cold surfaces, lab K5-425

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Farekilde: Waste disposal in general for the laboratories in K5

Uønsket hendelse: Incorrect waste handling

Konsekvensområde: Helse

Ytre miljø

Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 

Risiko før tiltak:  Risiko etter tiltak: 

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Disposal of Hg containing wastes

Konsekvensområde: Helse

Ytre miljø

Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 

Risiko før tiltak:  Risiko etter tiltak: 

Risiko før tiltak:  Risiko etter tiltak: 

Farekilde: Use of Freeze Dryer in lab UL-K5-315

Uønsket hendelse: Sample preparation (done in lab K5-317)

Konsekvensområde: Helse

Ytre miljø

Risiko før tiltak:  Risiko etter tiltak: 

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Freeze drying - ventilation failure

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Freeze drying - flask implosion

Konsekvensområde: Helse


Risiko før tiltak:  Risiko etter tiltak: 

Farekilde: Detection of produced ammonia in a photocatalytic setup lab K5-317, 228, 315

Uønsket hendelse: Waste handling of Nessler's reagent

Konsekvensområde: Helse

Ytre miljø

Risiko før tiltak:  Risiko etter tiltak: 


Risiko før tiltak:  Risiko etter tiltak: 



Farekilde: Detection of produced ammonia in a photocatalytic setup lab K5-317, 228, 315

Uønsket hendelse: Waste handling of Nessler's reagent

Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure of NH4Cl

Konsekvensområde: Helse
Ytre miljø

Risiko før tiltak:  Risiko etter tiltak: 
Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Exposure to Nessler's reagent

Konsekvensområde: Helse
Ytre miljø
Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 
Risiko før tiltak:  Risiko etter tiltak: 
Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Leakage from Nitrogen cylinder

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Use of UV-vis spectroscopy in Ugelstad laboratory, K5-315

Konsekvensområde: Helse
Materielle verdier

Risiko før tiltak:  Risiko etter tiltak: 
Risiko før tiltak:  Risiko etter tiltak: 

Farekilde: Working with solar simulator(ScienceTech SF-300-A) (lab K5-317 and K5-228)

Uønsket hendelse: Exposure to UVC-light

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Uønsket hendelse: Burns caused by touching the arc lamp envelope

Konsekvensområde: Helse

Risiko før tiltak:  Risiko etter tiltak: 

Endelig vurdering

Involverte enheter og personer

En risikovurdering kan gjelde for en, eller flere enheter i organisasjonen. Denne oversikten presenterer involverte enheter og personell for gjeldende risikovurdering.

Enhet /-er risikovurderingen omfatter

- Institutt for kjemisk prosessteknologi

Deltakere

Magnus Rønning

Estelle Marie M. Vanhaecke

Anne Hoff

Jibin Antony

Lesere

Karin Wiggen Dragsten

Jens Norrman

May Grete Sætran

Hege Johannessen

Andre involverte/interessenter

[Ingen registreringer]

Følgende akseptkriterier er besluttet for risikoområdet Risikovurdering: Helse, miljø og sikkerhet (HMS):

Helse



Materielle verdier



Omdømme



Ytre miljø



Oversikt over eksisterende, relevante tiltak som er hensyntatt i risikovurderingen

I tabellen under presenteres eksisterende tiltak som er hensyntatt ved vurdering av sannsynlighet og konsekvens for aktuelle uønskede hendelser.

Farekilde	Uønsket hendelse	Tiltak hensyntatt ved vurdering
Hydrothermal synthesis of BiO nanoparticles in lab K5-317	Exposure to and inhalation of dust from sodium oleate	Use of Personal Protective Equipment
	Exposure to and inhalation of bismuth (III) nitrate pentahydrate	Use of Personal Protective Equipment
	Exposure to and inhalation of bismuth (III) nitrate pentahydrate	Use a fume hood
	Exposure to Ethanol	Use of Personal Protective Equipment
Hydrothermal preparation of Bi ₂ O ₂ CO ₃ nanodisks in lab K5-317.	Exposure to and inhalation of bismuth (III) nitrate pentahydrate	Use of Personal Protective Equipment
	Exposure to and inhalation of bismuth (III) nitrate pentahydrate	Use a fume hood
	Exposure to Sodium Hydroxid	Use of Personal Protective Equipment
	Exposure to sodium citrate hydrate	
	Exposure to ethanol	
	Exposure to and inhalation of dust from urea	
	Exposure to polyvinylpyrrolidone (PVP)	Use of Personal Protective Equipment
	Exposure to HCl	
	Exposure to Sodium hydroxide	
Chemical bath deposition of AU nanoparticles onto the Bi ₂ O ₂ CO ₃ nanodisks in lab K5-317	Exposure to Gold(III) chloride hydrate	Use of Personal Protective Equipment
	Exposure to Gold(III) chloride hydrate	Use a fume hood
	Sodium sulfite in contact with acids	Use a fume hood
	Exposure to EDTA	Use of Personal Protective Equipment
	Exposure to Potassium phosphate monobasic	Use of Personal Protective Equipment
	Exposure to and inhalation of Hydrazine monohydrate	Use a filter mask
	Exposure to and inhalation of Hydrazine monohydrate	Use of Personal Protective Equipment
	Exposure to and inhalation of Hydrazine monohydrate	Use a fume hood
	Exposure to Palladium (II) chloride	Use of Personal Protective Equipment
	Exposure to Palladium (II) chloride	Use a fume hood
Use of furnaces (Kjemihall D) and vacuum oven (K5-215)	Accidentally touching a hot surface on the furnace may cause burns	Use of Personal Protective Equipment
Characterization of powder	High voltages in SEM, EDX (Nanolab, kjemiblokk 1)	
	Handling of nanoparticles for sample preparation for SEM, XRD (Nanolab and K2-113)	Use a filter mask



Characterization of powder	Handling of nanoparticles for sample preparation for SEM, XRD (Nanolab and K2-113)	Use of Personal Protective Equipment
	Handling of nanoparticles for sample preparation for SEM, XRD (Nanolab and K2-113)	Use a fume hood
	Hot surfaces (K5-441)	Use of Personal Protective Equipment
	X-ray radiation (K2-113)	
	Cold surfaces, lab K5-425	Use of Personal Protective Equipment
Waste disposal in general for the laboratories in K5	Incorrect waste handling	Use of Personal Protective Equipment
	Disposal of Hg containing wastes	Use a filter mask
	Disposal of Hg containing wastes	Use of Personal Protective Equipment
Use of Freeze Dryer in lab UL-K5-315	Sample preparation (done in lab K5-317)	Use a filter mask
	Sample preparation (done in lab K5-317)	Use of Personal Protective Equipment
	Sample preparation (done in lab K5-317)	Use a fume hood
	Freeze drying - ventilation failure	
	Freeze drying - flask implosion	
Detection of produced ammonia in a photocatalytic setup lab K5-317, 228, 315	Waste handling of Nessler's reagent	Use of Personal Protective Equipment
	Exposure of NH ₄ Cl	Use of Personal Protective Equipment
	Exposure to Nessler's reagent	Use a filter mask
	Exposure to Nessler's reagent	Use of Personal Protective Equipment
	Exposure to Nessler's reagent	Use a fume hood
	Leakage from Nitrogen cylinder	
	Use of UV-vis spectroscopy in Ugelstad laboratory, K5-315	Use of Personal Protective Equipment
Working with solar simulator (ScienceTech SF-300-A) (lab K5-317 and K5-228)	Exposure to UVC-light	Use of Personal Protective Equipment
	Burns caused by touching the arc lamp envelope	

Eksisterende og relevante tiltak med beskrivelse:**Use a filter mask**

[Ingen registreringer]

Use of Personal Protective Equipment

All work will be performed by using personal protective equipment such as coat, gloves and glasses all the time. Powder is handled in fume hood or filter mask is used. By handling nanoparticles a double set of nitril gloves and a filter mask specified for nanomaterials is used.

Use a fume hood

[Ingen registreringer]

If contact with eyes rinse with water for several minutes

[Ingen registreringer]

Risikoanalyse med vurdering av sannsynlighet og konsekvens

I denne delen av rapporten presenteres detaljer dokumentasjon av de farer, uønskede hendelser og årsaker som er vurdert. Innledningsvis oppsummeres farer med tilhørende uønskede hendelser som er tatt med i vurderingen.

Følgende farer og uønskede hendelser er vurdert i denne risikovurderingen:

- **Hydrothermal synthesis of BiO nanoparticles in lab K5-317**
 - Exposure to and inhalation of dust from sodium oleate
 - Exposure to and inhalation of bismuth (III) nitrate pentahydrate
 - Exposure to Ethanol
- **Hydrothermal preparation of Bi₂O₂CO₃ nanodisks in lab K5-317.**
 - Exposure to and inhalation of bismuth (III) nitrate pentahydrate
 - Exposure to Sodium Hydroxid
 - Exposure to sodium citrate hydrate
 - Exposure to ethanol
 - Exposure to and inhalation of dust from urea
 - Exposure to polyvinylpyrrolidone (PVP)
- **Chemical bath deposition of AU nanoparticles onto the Bi₂O₂CO₃ nanodisks in lab K5-317**
 - Exposure to HCl
 - Exposure to Sodium hydroxide
 - Exposure to Gold(III) chloride hydrate
 - Sodium sulfite in contact with acids
 - Exposure to EDTA
 - Exposure to Potassium phosphate monobasic
 - Exposure to and inhalation of Hydrazine monohydrate
 - Exposure to Palladium (II) chloride
- **Use of furnaces (Kjemihall D) and vacuum oven (K5-215)**
 - Accidentally touching a hot surface on the furnace may cause burns
- **Characterization of powder**
 - High voltages in SEM, EDX (Nanolab, kjemiblokk 1)
 - Handling of nanoparticles for sample preparation for SEM, XRD (Nanolab and K2-113)
 - Hot surfaces (K5-441)
 - X-ray radiation (K2-113)
 - Cold surfaces, lab K5-425
- **Waste disposal in general for the laboratories in K5**
 - Incorrect waste handling
 - Disposal of Hg containing wastes
- **Use of Freeze Dryer in lab UL-K5-315**
 - Sample preparation (done in lab K5-317)
 - Freeze drying - ventilation failure
 - Freeze drying - flask implosion
- **Detection of produced ammonia in a photocatalytic setup lab K5-317, 228, 315**
 - Waste handling of Nessler's reagent



- Exposure of NH_4Cl
- Exposure to Nessler's reagent
- Leakage from Nitrogen cylinder
- Use of UV-vis spectroscopy in Ugelstad laboratory, K5-315
- **Working with solar simulator (ScienceTech SF-300-A) (lab K5-317 and K5-228)**
 - Exposure to UVC-light
 - Burns caused by touching the arc lamp envelope

Detaljert oversikt over farekilder og uønskede hendelser:

Farekilde: Hydrothermal synthesis of BiO nanoparticles in lab K5-317

The BiO particles are made by weighing and adding sodium oleate and bismuth nitrate pentahydrate to distilled water. This will be done in a fume hood.

Then this solution will be mixed with vigorous stirring for 2 h before more distilled water is added. The suspension will then be transferred to a 50 mL Teflon-lined autoclave, sealed and heated at 140°C for 17 h.

The system will then be allowed to cool down to room temperature. The obtained solid products will be collected by centrifugation, washed with absolute ethanol three times, and then freeze-dried for further characterization.

Synthesis will be performed in lab K5-317.

Furnace in Kjemihall D will be used.

Freeze dryer in lab K5-315 will be used.

Centrifuge in lab K5-228 will be used.

Uønsket hendelse: Exposure to and inhalation of dust from sodium oleate

Exposure to and inhalation of dust from sodium oleate.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

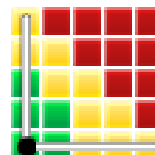
Gloves, lab coat and safety goggles are always used

Konsekvensområde: Helse

Vurdert konsekvens: **Liten (1)**

Kommentar: Non-hazardous

Risiko:



Uønsket hendelse: Exposure to and inhalation of bismuth (III) nitrate pentahydrate

Upon exposure of $\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$, it causes skin irritation, severe eye irritation, irritation of respiratory system upon inhalation. It can cause fire as it is oxidizing.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

Kommentar:

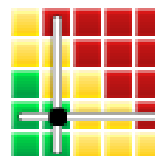
Gloves, lab coat and safety goggles are always used.

Konsekvensområde: Helse

Vurdert konsekvens: **Middels (2)**

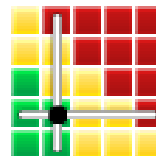
Kommentar: $\text{Bi}(\text{NO}_3)_3 \cdot 5\text{H}_2\text{O}$ is hazardous in case of skin contact (irritant), of eye contact (irritant), of inhalation and ingestion.

Risiko:

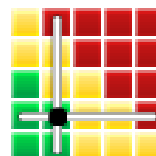


Konsekvensområde: Ytre miljøVurdert konsekvens: **Middels (2)**

Kommentar: May cause fire, is oxidizing.

Risiko:**Konsekvensområde: Materielle verdier**Vurdert konsekvens: **Middels (2)**

Kommentar: May cause fire, is oxidizing.

Risiko:**Uønsket hendelse: Exposure to Ethanol**

Ethanol should be kept away from heat and hot surfaces. Ethanol is flammable both as liquid and steam.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

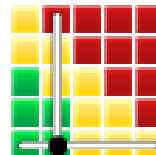
Potential ignition sources are isolated in the lab, little exposure to ignition sources. Using fume hoods remove flammable vapors. Gloves, lab coat and safety goggles are always used.

Konsekvensområde: HelseVurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Risiko:**Konsekvensområde: Ytre miljø**Vurdert konsekvens: **Middels (2)**

Kommentar: Flammable

Risiko:**Konsekvensområde: Materielle verdier**Vurdert konsekvens: **Middels (2)**

Kommentar: Flammable

Risiko:

Farekilde: Hydrothermal preparation of Bi₂O₂CO₃ nanodisks in lab K5-317.

Bi(NO₃)₃, CO(NH₂)₂ and Na₃C₆H₅O₇ will be weighed and dissolved in NaOH (1 M) aqueous solution under magnetic stirring at 600 rpm for 60 min. The prepared homogeneous solution will be transferred into a 45 mL Teflon-lined stainless steel autoclave, sealed and placed in an oven at 180 °C for 6 h. After the hydrothermal treatment, the autoclave will be cooled to room temperature. The precipitate will be collected by centrifugation and washed with copious amounts of distilled water and absolute ethanol several times, assisted by sonication treatment to ensure the complete removal of the possible residues. Finally, the obtained sample will be dried in a vacuum oven at 80 °C overnight.

Synthesis will be performed in lab K5-317.
Furnace in Kjemihall D will be used.
Vacuum oven in lab K5-215 will be used.
Centrifuge in lab K5-228 will be used.

Uønsket hendelse: Exposure to and inhalation of bismuth (III) nitrate pentahydrate

Upon exposure of Bi(NO₃)₃·5H₂O, it causes skin irritation, severe eye irritation, irritation of respiratory system upon inhalation. It can cause fire as it is oxidizing.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

Kommentar:

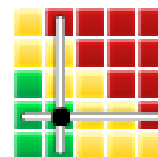
Gloves, lab coat and safety goggles are always used.

Konsekvensområde: Helse

Vurdert konsekvens: **Middels (2)**

Kommentar: [Ingen registreringer]

Risiko:

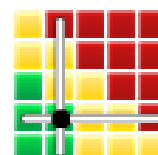


Konsekvensområde: Ytre miljø

Vurdert konsekvens: **Middels (2)**

Kommentar: May cause fire, is oxidizing.

Risiko:

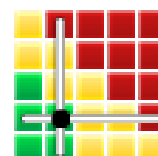


Konsekvensområde: Materielle verdier

Vurdert konsekvens: **Middels (2)**

Kommentar: May cause fire, is oxidizing.

Risiko:



Uønsket hendelse: Exposure to Sodium Hydroxid

NaOH can be corrosive for metals, can give serious chemical burns (etseskade) on skin and eyes.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Svært lite sannsynlig (1)**

Kommentar:

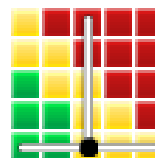
Protective gloves, lab coat and safety goggles are always used.

Konsekvensområde: Helse

Vurdert konsekvens: **Stor (3)**

Kommentar: Can give serious chemical burns (etseskade) on skin and eyes.

Risiko:

**Konsekvensområde: Materielle verdier**

Vurdert konsekvens: **Middels (2)**

Kommentar: Corrosive to metals

Risiko:

**Uønsket hendelse: Exposure to sodium citrate hydrate**

Not a hazardous chemical.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Svært lite sannsynlig (1)**

Kommentar:

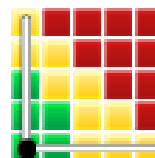
Protective glasses, gloves and lab coat will be used.

Konsekvensområde: Helse

Vurdert konsekvens: **Liten (1)**

Kommentar: Not a hazardous chemical.

Risiko:



Uønsket hendelse: Exposure to ethanol

Ethanol should be kept away from heat and hot surfaces. Ethanol is flammable both as liquid and steam.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

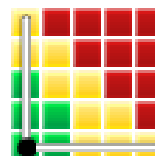
Potential ignition sources are isolated in the lab, little exposure to ignition sources. Using fume hoods remove flammable vapors.

Konsekvensområde: Helse

Vurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Risiko:

**Konsekvensområde: Ytre miljø**

Vurdert konsekvens: **Middels (2)**

Kommentar: [Ingen registreringer]

Risiko:

**Konsekvensområde: Materielle verdier**

Vurdert konsekvens: **Middels (2)**

Kommentar: [Ingen registreringer]

Risiko:



Uønsket hendelse: Exposure to and inhalation of dust from urea

Urea ($\text{CO}(\text{NH}_2)_2$) is non hazardous

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

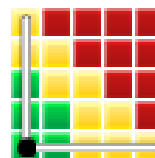
Gloves, lab coat and safety goggles are always used.

Konsekvensområde: Helse

Vurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Risiko:

**Uønsket hendelse: Exposure to polyvinylpyrrolidone (PVP)**

PVP is not hazardous.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

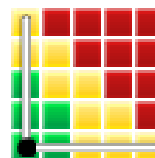
Gloves, lab coat and safety goggles are always used.

Konsekvensområde: Helse

Vurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Risiko:



Farekilde: Chemical bath deposition of AU nanoparticles onto the Bi₂O₂CO₃ nanodisks in lab K5-317

Au NPs will be uniformly loaded on the surface of the as-obtained nanodisks via chemical bath deposition (CBD). Specifically, 40 mg of the obtained Bi₂O₂CO₃ nanodisks will first be activated in a solution containing 1 g/L PdCl₂ and 5 g/L HCl for 2 h by sonication and dry in a vacuum oven. After the activation treatment, the Pd colloids on the surface of the nanodisks will provide the catalytic sites for the electron transfer and nucleation and growth of Au nanoparticles.

The deposition solution will be prepared by dissolving HAuCl₄, Na₂SO₃, EDTA and KH₂PO₄ in 4 mL of H₂O. The pH of the solution will be adjusted to 9.0 with the addition of 1 M NaOH dropwise. Then, 10 mg of activated nanodisks will be dispersed into the as-prepared solution under vigorous stirring. Subsequently, N₂H₄·H₂O will be added into the suspension followed by another 2 h stirring at 60 °C.

After removing the upper, clear solution, the obtained sample will be rinsed with distilled water for 3 times and dried in a vacuum oven at 60 °C overnight.

Synthesis will be performed in lab K5-317.
Vacuum oven in lab K5-215 will be used.
Centrifuge in lab K5-228 will be used.

Uønsket hendelse: Exposure to HCl

HCl can be corrosive for metals, may cause serious chemical burns in contact with skin and eyes. May cause irritation of airways.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

Gloves, lab coat and safety goggles are always used. Work done in fume hood, avoid inhalation.

Konsekvensområde: Helse

Vurdert konsekvens: **Stor (3)**

Kommentar: May give serious chemical burns on skin and eyes. May cause irritation of airways in case of inhalation.

Risiko:

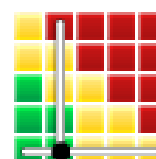


Konsekvensområde: Materielle verdier

Vurdert konsekvens: **Middels (2)**

Kommentar: Can be corrosive for metals

Risiko:



Uønsket hendelse: Exposure to Sodium hydroxide

NaOH can be corrosive for metals, can give serious chemical burns (etseskade) on skin and eyes.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Svært lite sannsynlig (1)**

Kommentar:

Protective gloves, lab coat and safety goggles are always used.

Konsekvensområde: Helse

Vurdert konsekvens: **Stor (3)**

Kommentar: Can give chemical burns on skin and eyes.

Risiko:

**Konsekvensområde: Materielle verdier**

Vurdert konsekvens: **Middels (2)**

Kommentar: Can be corrosive to other metals

Risiko:

**Uønsket hendelse: Exposure to Gold(III) chloride hydrate**

Harmful if swallowed, gives serious chemical burns if in contact with skin and eyes, may cause allergic skin reaction.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Svært lite sannsynlig (1)**

Kommentar:

Protective gloves, lab coat and safety goggles are always used. Kept far away from the face to avoid swallowing. Work in a fume hood.

Konsekvensområde: Helse

Vurdert konsekvens: **Stor (3)**

Kommentar: It is harmful if swallowed and can serious chemical burns on skin and eyes if exposed. It can also trigger allergic skin reaction.

Risiko:



Uønsket hendelse: Sodium sulfite in contact with acids

If sodium sulfite is in contact with acids, toxic gas evolve

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

Keep it away from direct contact with acids. So I will keep it away from direct contact with HCl.

Konsekvensområde: Helse

Vurdert konsekvens: **Middels (2)**

Kommentar: Can evolve toxic gas in contact with acid

Risiko:

**Uønsket hendelse: Exposure to EDTA**

Can give serious eye irritation upon exposure.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

Protective gloves, lab coat and safety goggles are always used.

Konsekvensområde: Helse

Vurdert konsekvens: **Middels (2)**

Kommentar: Can give serious eye irritation

Risiko:



Uønsket hendelse: Exposure to Potassium phosphate monobasic

Non-hazardous

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

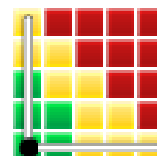
[Ingen registreringer]

Konsekvensområde: Helse

Vurdert konsekvens: **Liten (1)**

Kommentar: [Ingen registreringer]

Risiko:



Uønsket hendelse: Exposure to and inhalation of Hydrazine monohydrate

Toxic if swallowed or in contact with skin. Serious chemical burns if contact with skin and eyes. May cause allergic skin reaction. Deadly if inhaled. May cause cancer. Very toxic, with long term effect, for life in water. Exposure will be registered in the exposure list.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

Protective gloves, lab coat and safety goggles are always used. Filter mask will also be used. Use of fume hood. Careful handling of waste disposal. Keep away from the face.

Konsekvensområde: Helse

Vurdert konsekvens: **Katastrofal (5)**

Kommentar: Toxic if swallowed or in contact with skin. Serious chemical burns if contact with skin and eyes. May cause allergic skin reaction. Deadly if inhaled. May cause cancer.

Risiko:

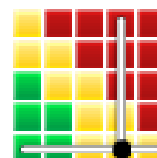


Konsekvensområde: Ytre miljø

Vurdert konsekvens: **Svært stor (4)**

Kommentar: Very toxic, with long term effect, for life in water.

Risiko:



Uønsket hendelse: Exposure to Palladium (II) chloride

PdCl₂ is toxic if swallowed and may trigger an allergic skin reaction.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

Gloves, lab coat and safety goggles are always used. It will be kept far away the face to avoid swallowing.

Konsekvensområde: Helse

Vurdert konsekvens: **Stor (3)**

Kommentar: It is toxic if swallowed. May cause allergic skin reaction

Risiko:



Farekilde: Use of furnaces (Kjemihall D) and vacuum oven (K5-215)

An autoclave will be heated to 140C and 180C in the hydrothermal preparation of BiO and Bi₂O₂CO₃ particles in an oven. A vacuum oven will be used at 60-80C.

Uønsket hendelse: Accidentally touching a hot surface on the furnace may cause burns
.....

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

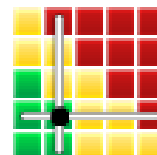
Kommentar:

The autoclave is placed in a closed cabinet, which reduces the likelihood of accidentally touching a hot surface. It has a visible display which displays the temperature in the oven, and heat protective gloves are available. I will let it cool down to room temperature before taking it out of oven.

Konsekvensområde: Helse

Vurdert konsekvens: **Middels (2)**

Kommentar: A burn from touching the furnace for a very short time (reflex to draw hand away from heat) is not likely to require more medical attention than basic first aid (cooling with water for ca. 20 min.)

Risiko:

Farekilde: Characterization of powder

Both powders will be investigated by 1) Brunauer–Emmett–Teller (BET), 2) Scanning electron microscopy (SEM), 3) Thermogravimetric analysis (TGA), 4) Energy-dispersive X-ray spectroscopy (EDX), 5) X-Ray Diffraction (XRD)

Uønsket hendelse: High voltages in SEM, EDX (Nanolab, kjemiblokk 1)

The SEM utilises potentially dangerous electrical currents (100 V AC and 30 kV DC) during operation. This could cause an electric shock if a cover is removed from the unit and internal parts are touched.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

[Ingen registreringer]

Konsekvensområde: Helse

Vurdert konsekvens: **Katastrofal (5)**

Kommentar: [Ingen registreringer]

Risiko:



Uønsket hendelse: Handling of nanoparticles for sample preparation for SEM, XRD (Nanolab and K2-113)

Exposure to and inhalation of BiO and Bi₂O₂CO₃ nanoparticle powder.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

Kommentar:

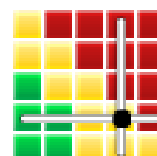
Due to the fact that nanoparticles sometimes possess very different properties to the same substances when in macro scale, they must be handled carefully. A double set of gloves (nitril, latex or neoprene) will always be used when working with nanoparticles. A filter mask specified for nanoparticles will be used. Lab coat and safety goggles will always be used. The particles will be kept in closed tubes when moved outside the fume hood, and samples will always be prepared inside a fume hood before transported in a closed container. If there is any spill of particles this will be cleaned as soon as possible, and the gloves will quickly be changed so that the particles do not absorb into the skin.

Konsekvensområde: Helse

Vurdert konsekvens: **Svært stor (4)**

Kommentar: Due to the fact that nanoparticles sometimes possess very different properties to the same substances when in macro scale, they must be handled carefully. Nanoparticles may show different physicochemical properties than in macro form, which can potentially result in an altered hazard profile. Physicochemical changes of particular concern include potential increase in flammability, self-heating properties and dust explosivity. Nanoparticles may also interact with biological systems differently from larger particles of the same material, e.g. altered rates of adsorption into the body through inhalation, ingestion or skin contact. There is currently uncertainty as to the extent to which the various characteristics of nanoparticles influence toxicity. Specially the handling of dry nanoparticles after freeze drying increases the risk.

Risiko:



Uønsket hendelse: Hot surfaces (K5-441)

During thermogravimetric analysis, the temperature inside the instrument can exceed 850 C. The instrument is well sealed, but the user should be aware of the high temperatures and possibly hot surfaces.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

Kommentar:

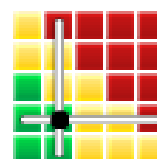
[Ingen registreringer]

Konsekvensområde: Helse

Vurdert konsekvens: **Middels (2)**

Kommentar: [Ingen registreringer]

Risiko:

**Uønsket hendelse: X-ray radiation (K2-113)**

X-ray radiation is harmful to the human body. A localised dose is sufficient to cause a severe radiation burn (human tissues are killed). Doses are also accumulated in the human body by long term exposed to radiation that produce irradiated cells. The hazards include an increased risk of leukaemia, cancer and genetic or hereditary effects.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

[Ingen registreringer]

Konsekvensområde: Helse

Vurdert konsekvens: **Katastrofal (5)**

Kommentar: [Ingen registreringer]

Risiko:



Uønsket hendelse: Cold surfaces, lab K5-425

Use of liquid nitrogen when preparing the instrument set-up.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

Kommentar:

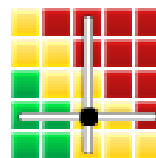
Follow the description for how to fill nitrogen closely, and use cold protective gloves.

Konsekvensområde: Helse

Vurdert konsekvens: **Stor (3)**

Kommentar: Liquid nitrogen is very cold (77K) so a spill on the skin can cause serious frostbites.

Risiko:



Farekilde: Waste disposal in general for the laboratories in K5

Contaminated gloves, paper, reusable equipment etc. will be disposed in the separate waste bin in the lab. If any glass is contaminated, broken or need to be disposed it will also be disposed in a separate waste bin. Liquid chemicals will also be disposed in separate containers according to which chemicals it contains.

Uønsket hendelse: Incorrect waste handling

There can be a high risk of disposing waste in the wrong waste bin/container.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

Kommentar:

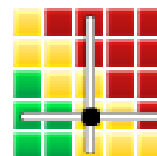
[Ingen registreringer]

Konsekvensområde: Helse

Vurdert konsekvens: **Stor (3)**

Kommentar: [Ingen registreringer]

Risiko:

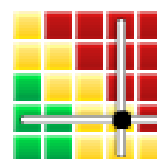


Konsekvensområde: Ytre miljø

Vurdert konsekvens: **Svært stor (4)**

Kommentar: Hydrazine monohydrate is very toxic, with long term effect, for life in water.

Risiko:

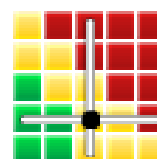


Konsekvensområde: Materielle verdier

Vurdert konsekvens: **Stor (3)**

Kommentar: [Ingen registreringer]

Risiko:



Uønsket hendelse: Disposal of Hg containing wastes

Wastes contaminated with mercury from Nessler's reagent will be disposed off separately. Separate containers will be used for liquid and solid (gloves and other solid materials) wastes. A register will be maintained in order to monitor the mercury content in the waste container.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

Kommentar:

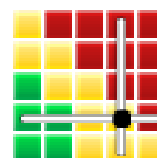
[Ingen registreringer]

Konsekvensområde: Helse

Vurdert konsekvens: **Svært stor (4)**

Kommentar: -Nesslers reagent could be fatal if swallowed or in contact with skin
-Causes severe skin burns and eye damage.
-toxic if inhaled
-may cause damage to organs through prolonged or repeated exposure.

Risiko:

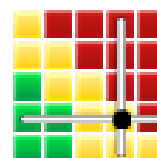


Konsekvensområde: Ytre miljø

Vurdert konsekvens: **Svært stor (4)**

Kommentar: Very toxic to aquatic life with long lasting effects.

Risiko:

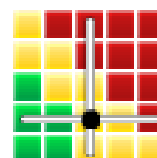


Konsekvensområde: Materielle verdier

Vurdert konsekvens: **Stor (3)**

Kommentar: May be corrosive to metals

Risiko:



Farekilde: Use of Freeze Dryer in lab UL-K5-315

A freeze dryer in the Uglestad-lab (K5-315) will be used after the hydrothermal synthesis of the BiO nanoparticles.

Uønsket hendelse: Sample preparation (done in lab K5-317)

First, the particles will be collected through centrifugation in lab K5-228 and washed with ethanol. Then they will be diluted with distilled water in the fume hood in K5-317. The particles will be kept in the centrifuge tube so that the nanoparticles do not escape. The centrifuge tube will first be placed in a beaker and then inside the instrument flask in the fume hood in lab K5-317 before it will be carefully moved to lab K5-315 for use in the freeze dryer.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

Kommentar:

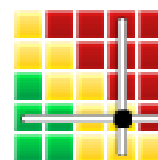
Due to the fact that nanoparticles sometimes possess very different properties to the same substances when in macro scale, they must be handled carefully. A double set of gloves (nitril, latex or neoprene) will always be used when working with nanoparticles. A filter mask specified for nanoparticles will be used. Lab coat and safety goggles will always be used. The particles will be kept in closed tubes when moved outside the fume hood, as described in the description. If there is any spill of particles this will be cleaned as soon as possible, and the gloves will quickly be changed so that the particles do not absorb into the skin.

Konsekvensområde: Helse

Vurdert konsekvens: **Svært stor (4)**

Kommentar: Due to the fact that nanoparticles sometimes possess very different properties to the same substances when in macro scale, they must be handled carefully. Nanoparticles may show different physicochemical properties than in macro form, which can potentially result in an altered hazard profile. Physicochemical changes of particular concern include potential increase in flammability, self-heating properties and dust explosivity. Nanoparticles may also interact with biological systems differently from larger particles of the same material, e.g. altered rates of adsorption into the body through inhalation, ingestion or skin contact. There is currently uncertainty as to the extent to which the various characteristics of nanoparticles influence toxicity. Specially the handling of dry nanoparticles after freeze drying increases the risk.

Risiko:

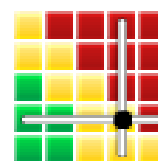


Konsekvensområde: Ytre miljø

Vurdert konsekvens: **Svært stor (4)**

Kommentar: Due to the fact that nanoparticles sometimes possess very different properties to the same substances when in macro scale, they must be handled carefully. Nanoparticles may show different physicochemical properties than in macro form, which can potentially result in an altered hazard profile. Physicochemical changes of particular concern include potential increase in flammability, self-heating properties and dust explosivity. Nanoparticles may also interact with biological systems differently from larger particles of the same material, e.g. altered rates of adsorption into the body through inhalation, ingestion or skin contact. There is currently uncertainty as to the extent to which the various characteristics of nanoparticles influence toxicity. Specially the handling of dry nanoparticles after freeze drying increases the risk.

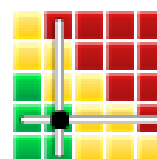
Risiko:



Uønsket hendelse: Freeze drying - ventilation failure

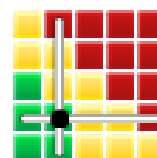
*Sannsynlighet for hendelsen (felles for alle konsekvensområder):***Lite sannsynlig (2)***Kommentar:*

[Ingen registreringer]

Konsekvensområde: Helse*Vurdert konsekvens: Middels (2)**Kommentar:* Work with aqueous samples**Risiko:****Uønsket hendelse: Freeze drying - flask implosion**

*Sannsynlighet for hendelsen (felles for alle konsekvensområder):***Lite sannsynlig (2)***Kommentar:*

Examine glassware before use.

Konsekvensområde: Helse*Vurdert konsekvens: Middels (2)**Kommentar:* The freeze dryer is placed in a separate room. Only aqueous solutions can be used, and will be kept inside centrifuge tubes, therefore there is no risk of solvent inhalation while using the instrument**Risiko:**

Farekilde: Detection of produced ammonia in a photocatalytic setup lab K5-317, 228, 315

Nessler's reagent and NH₄OH will be used to make a calibration curve for ammonia concentration by using UV-vis. The UV-vis will be in lab 315. The photocatalyst samples will be tested in water systems with a certain amount of methanol added. Solar lamp of 150 W will be used, and the system will be purged with N₂-gas before closing the system and irradiate the reactor. Samples will be taken out over time, react with Nessler's reagent and then detect the ammonia concentration by UV-vis. Ammonia produced in the aqueous phase via photocatalysis will be detected using Nessler's reagent. The photocatalytic reactions will be performed initially in K5 317, however the new setup would be moved to K5 228.

Uønsket hendelse: Waste handling of Nessler's reagent

Nessler's reagent will be used for detection of ammonia concentration in aqueous solution.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

Kommentar:

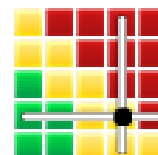
Will prevent leakage and spillage, and not let the product enter the drain. Disposal will be treated carefully and kept in a separate container ("toxic inorganic waste") and sent to a licensed disposal company in accordance with the HSE guidelines for NTNU.

Personal protective equipment will be used, such as eye protection and skin protection (nitrile gloves). Only small amounts (a few mL of reagent) will be used at a time. Keep away from metals to avoid corrosion.

Konsekvensområde: Helse

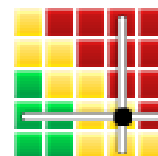
Vurdert konsekvens: **Svært stor (4)**

Kommentar: Fatal if swallowed in in contact with skin. Causes severe skin burns and eye damage. Toxic if inhaled. May cause damage to organs through prolonged or repeated exposure. It contains mercury

Risiko:

Konsekvensområde: Ytre miljø

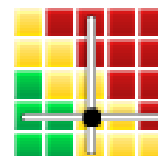
Vurdert konsekvens: **Svært stor (4)**

Kommentar: Very toxic to aquatic life with long lasting effects. It contains mercury.

Risiko:

Konsekvensområde: Materielle verdier

Vurdert konsekvens: **Stor (3)**

Kommentar: May be corrosive to metals.

Risiko:


Uønsket hendelse: Exposure of NH₄Cl

Will be used together with Nessler's reagent for the calibration curve for detection of ammonia.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

Kommentar:

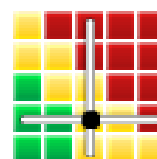
Will avoid release to the environment and collect spillage. Wear protective gloves and clothes, and eye protection.

Konsekvensområde: Helse

Vurdert konsekvens: **Stor (3)**

Kommentar: Harmful if swallowed. Causes severe skin burns and eye damage. May cause respiratory irritation.

Risiko:

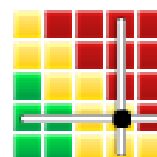


Konsekvensområde: Ytre miljø

Vurdert konsekvens: **Svært stor (4)**

Kommentar: Very toxic to aquatic life.

Risiko:



Uønsket hendelse: Exposure to Nessler's reagent

Nessler's reagent is a mercury compound. Spillage of Nessler's reagent to the drain can be disastrous. It is very toxic to aquatic life and has long lasting effects. Can have fatal effects in humans if swallowed and causes severe skin burns and eye damage.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Lite sannsynlig (2)

Kommentar:

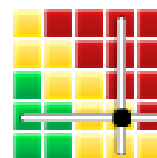
Will prevent leakage and spillage, and not let the product enter the drain. Personal protective equipment such as goggles, face shield, nitrile gloves and lab coat will be used while handling the chemical. Only small amounts (a few micro liters of reagent) will be used at a time. The chemical will be used inside a fumehood. Will be kept away from metals to avoid corrosion. The chemical bottle will be placed in a separate container in the chemical cabinet marked with all relevant pictograms. All lab users will be notified about the use of this chemical. In case of accidental spill, inert absorbent material will be used to soak up the chemical and will be disposed off as hazardous waste. Wastes will be segregated carefully and kept in a separate container ("mercury waste") and sent to a licensed disposal company in accordance with the HSE guidelines for NTNU. Different waste containers will be used for solid/liquid waste.

Konsekvensområde: Helse

Vurdert konsekvens: **Svært stor (4)**

Kommentar: Fatal if swallowed in in contact with skin. Causes severe skin burns and eye damage. Toxic if inhaled. May cause damage to organs through prolonged or repeated exposure.

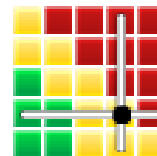
Risiko:



Konsekvensområde: Ytre miljø

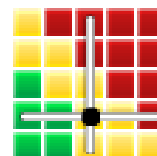
Vurdert konsekvens: **Svært stor (4)**

Kommentar: Very toxic to aquatic life with long lasting effects.

Risiko:**Konsekvensområde: Materielle verdier**

Vurdert konsekvens: **Stor (3)**

Kommentar: May be corrosive to metals.

Risiko:**Uønsket hendelse: Leakage from Nitrogen cylinder**

Nitrogen flow from a cylinder will be used for purging the reactor vessel prior to impinging it with solar simulated light.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

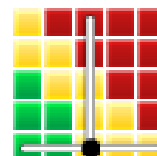
Kommentar:

Training's on handling gas cylinders have been obtained. Ensuring sufficient ventilation in the labs.

Konsekvensområde: Helse

Vurdert konsekvens: **Stor (3)**

Kommentar: Nitrogen can act as a simple asphyxiant by displacing oxygen in air to levels below that required to support life. In addition, nitrogen gas stored in pressurized containers is stored energy that can cause serious injury or death if released in an uncontrolled manner.

Risiko:

Uønsket hendelse: Use of UV-vis spectroscopy in Ugelstad laboratory, K5-315

The UV-vis spectroscopy in Ugelstad laboratory will be used for detection of the ammonia produced during photocatalytic reaction in lab K5-317. Nessler reagent will be added in lab K5-317, and all the preparation will be done there. Then the samples containing Nessler's reagent will be moved to lab K5-315 in closed vials or eppendorf tubes. The measurements will be performed in lab 315, but all the waste (both liquid waste and gloves, pipettes etc.) will be collected and brought back to lab 317 for disposal. No waste will be disposed for these samples in lab 315.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

Kommentar:

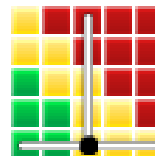
[Ingen registreringer]

Konsekvensområde: Helse

Vurdert konsekvens: **Stor (3)**

Kommentar: Nessler's reagent contains very small traces of mercury

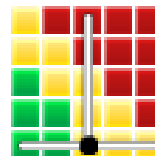
Risiko:

**Konsekvensområde: Materielle verdier**

Vurdert konsekvens: **Stor (3)**

Kommentar: Nessler's reagent contains very small traces of mercury

Risiko:



Farekilde: Working with solar simulator(ScienceTech SF-300-A) (lab K5-317 and K5-228)

A 150W and a 300W solar simulator will be used to generate a power output of 1 Sun for the photocatalytic studies. This instrument will be used to obtain controllable laboratory conditions of illumination approximating natural sunlight

Uønsket hendelse: Exposure to UVC-light

During the photodeposition one is exposed to UV-light for a short time.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Sannsynlig (3)

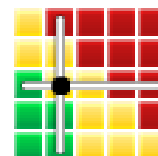
Kommentar:

By operating the photoreactor one is exposed to UV-light, so after turning on the UV-light the reactor should be left alone with minimal adjustments to avoid exposure to skin and eyes. Protective glasses should be used.

Konsekvensområde: Helse

Vurdert konsekvens: **Middels (2)**

Kommentar: Can cause sunburns, eye problems or allergic reactions. Severe exposure can cause skin cancer.

Risiko:**Uønsket hendelse: Burns caused by touching the arc lamp envelope**

The arc lamp envelope of the solar simulator reaches very high temperatures during normal operations and can cause severe burns if touched.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

Svært lite sannsynlig (1)

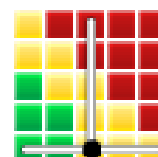
Kommentar:

Let the lamp cool at least 15 minutes before opening the lamp compartment door. The manufacturer's manual will be looked for further assistance on safety-related information before using the equipment or during maintenance.

Konsekvensområde: Helse

Vurdert konsekvens: **Stor (3)**

Kommentar: [Ingen registreringer]

Risiko:



Oversikt over besluttede risikoreduserende tiltak:

Under presenteres en oversikt over risikoreduserende tiltak som skal bidra til å reduseres sannsynlighet og/eller konsekvens for uønskede hendelser.

Detaljert oversikt over besluttede risikoreduserende tiltak med beskrivelse:



Detaljert oversikt over vurdert risiko for hver farekilde/uønsket hendelse før og etter besluttede tiltak