



<b>ID</b>	30990	<b>Status</b>	<b>Dato</b>
<b>Risikoområde</b>	Risikovurdering: Helse, miljø og sikkerhet (HMS)	Opprettet	08.01.2019
<b>Opprettet av</b>	Viviann Hole	Vurdering startet	08.01.2019
<b>Ansvarlig</b>	Viviann Hole	Tiltak besluttet	
		Avsluttet	

**Risikovurdering:****Master student, Viviann Hole, 2019, Hydrothermal synthesis of SBN nanorod arrays****Gyldig i perioden:**

1/8/2019 - 7/1/2019

**Sted:**

K2 and NanoLab

**Mål / hensikt**

The goal is to evaluate and lower the risk associated with the project work.

**Bakgrunn**

SBN is a lead-free piezoelectrical material which has good outlooks.

**Beskrivelse og avgrensninger**

Make Nb-acid ( $\text{Nb}_2\text{O}_5$ ) from ammonium niobate(V)oxalate hydrate and washing with ammonia solution. Standardize the Nb-acid. Mix Nb-acid, Ba- and Sr-nitrate and pour in Teflon cup, with a substrate in most cases, and put in an autoclave. Heating of the autoclave to 250 C, hydrothermal synthesis. Wash and dry the substrate with attached nanorods and remaining powder. Characterization with XRD, SEM, and PFM.

**Forutsetninger, antakelser og forenklinger**

[Ingen registreringer]

**Vedlegg**

Ammoniakk-løsning 28%.PDF  
Ammonium niobate(V)oxalate hydrate.pdf  
Bariumnitrat.pdf  
Strontium nitrat.pdf  
Niobium(V)oxide.pdf  
Magnesium oxide.pdf  
Strontium titanat.pdf  
NitricAcid.PDF  
Sodium dodecylbenzenesulfonate.pdf  
Sodium dodecyl sulfate.pdf  
Sodium hydroxide.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.

<b>Farekilde:</b>	<b>Prepare Nb-acid</b>		
<b>Uønsket hendelse:</b>	<b>Eye and skin contact with chemicals</b>		
<b>Konsekvensområde:</b>	Helse	Risiko før tiltak:	Risiko etter tiltak:
			
<b>Uønsket hendelse:</b>	<b>Inhalation of chemicals</b>		
<b>Konsekvensområde:</b>	Helse	Risiko før tiltak:	Risiko etter tiltak:
			
<b>Farekilde:</b>	<b>Preparation of solution used for hydrothermal synthesis.</b>		
<b>Uønsket hendelse:</b>	<b>Eye and skin contact with chemicals</b>		
<b>Konsekvensområde:</b>	Helse	Risiko før tiltak:	Risiko etter tiltak:
			
<b>Uønsket hendelse:</b>	<b>Inhalation of chemicals</b>		
<b>Konsekvensområde:</b>	Helse	Risiko før tiltak:	Risiko etter tiltak:
			
<b>Uønsket hendelse:</b>	<b>Ignition of chemicals</b>		
<b>Konsekvensområde:</b>	Helse	Risiko før tiltak:	Risiko etter tiltak:
			
<b>Farekilde:</b>	<b>Hydrothermal synthesis</b>		
<b>Uønsket hendelse:</b>	<b>Burn</b>		
<b>Konsekvensområde:</b>	Helse	Risiko før tiltak:	Risiko etter tiltak:
			
<b>Uønsket hendelse:</b>	<b>High pressure</b>		
<b>Konsekvensområde:</b>	Helse	Risiko før tiltak:	Risiko etter tiltak:
			



**Farekilde:** Hydrothermal synthesis

**Uønsket hendelse:** Contact with substrate used in synthesis

**Konsekvensområde:** Helse

Risiko før tiltak:  Risiko etter tiltak: 

**Farekilde:** Standardization of Nb-acid solution

**Uønsket hendelse:** Burn

**Konsekvensområde:** Helse

Risiko før tiltak:  Risiko etter tiltak: 

**Uønsket hendelse:** Gas accumulation

**Konsekvensområde:** Helse

Risiko før tiltak:  Risiko etter tiltak: 

**Farekilde:** Post synthesis treatment

**Uønsket hendelse:** Washing and centrifugation

**Konsekvensområde:** Helse

Risiko før tiltak:  Risiko etter tiltak: 

**Uønsket hendelse:** Inhalation of powder/dried nanorods.

**Konsekvensområde:** Helse

Risiko før tiltak:  Risiko etter tiltak: 

**Farekilde:** X-ray diffraction

**Uønsket hendelse:** Contact and inhalation of material






**Konsekvensområde:** Helse

Risiko før tiltak:  Risiko etter tiltak: 

**Uønsket hendelse:** Operation of instrument

**Konsekvensområde:** Helse

Risiko før tiltak:  Risiko etter tiltak: 

**Farekilde:** SEM imaging**Uønsket hendelse:** Contact and inhalation of material**Konsekvensområde:** HelseRisiko før tiltak:  Risiko etter tiltak: **Uønsket hendelse:** Operation of instrument**Konsekvensområde:** HelseRisiko før tiltak:  Risiko etter tiltak: **Farekilde:** AFM**Uønsket hendelse:** Contact or inhalation of material**Konsekvensområde:** HelseRisiko før tiltak:  Risiko etter tiltak: **Farekilde:** Mortaring powders**Uønsket hendelse:** Skin or eye contact with powder**Konsekvensområde:** HelseRisiko før tiltak:  Risiko etter tiltak: **Uønsket hendelse:** Inhalation of powder**Konsekvensområde:** HelseRisiko før tiltak:  Risiko etter tiltak: **Farekilde:** Preparation of substrate holder**Uønsket hendelse:** Cut and squeezing of skin**Konsekvensområde:** HelseRisiko før tiltak:  Risiko etter tiltak: **Farekilde:** Washing of autoclave**Uønsket hendelse:** Contact with acid**Konsekvensområde:** HelseRisiko før tiltak:  Risiko etter tiltak: 



Farekilde: Washing of autoclave

Uønsket hendelse: Inhalation of acid

Konsekvensområde: Helse Risiko før tiltak: Risiko etter tiltak:

Uønsket hendelse: Contact or inhalation of base

Konsekvensområde: Helse Risiko før tiltak: Risiko etter tiltak:

Farekilde: Ferroelectric measuremets

Uønsket hendelse: High voltage

Konsekvensområde: Helse Risiko før tiltak: Risiko etter tiltak:

Endelig vurdering  
Godkjent. Mari-Ann Einarsrud

## 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 materialteknologi

### Deltakere

Mari-Ann Einarsrud  
Anders Bank Blichfeld  
Solveig Stubmo Aamlid  
Eva Rise  
Kenneth Marshall  
Ola Gjønnnes Grendal

### Lesere

[Ingen registreringer]

### 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
Prepare Nb-acid	Eye and skin contact with chemicals	
	Inhalation of chemicals	Fume hood
Preparation of solution used for hydrothermal synthesis.	Eye and skin contact with chemicals	
	Inhalation of chemicals	
	Ignition of chemicals	
Hydrothermal synthesis	Burn	
	High pressure	
	Contact with substrate used in synthesis	Nitrile gloves
Standardization of Nb-acid solution	Burn	
	Gas accumulation	
Post synthesis treatment	Washing and centrifugation	
	Inhalation of powder/dried nanorods.	
X-ray diffraction	Contact and inhalation of material	
	Operation of instrument	
SEM imaging	Contact and inhalation of material	
	Operation of instrument	
AFM	Contact or inhalation of material	
Mortaring powders	Skin or eye contact with powder	
	Inhalation of powder	
Preparation of substrate holder	Cut and squeezing of skin	
Washing of autoclave	Contact with acid	Fume hood
	Inhalation of acid	Fume hood
	Contact or inhalation of base	Nitrile gloves
Ferroelectric measurements	High voltage	Interlock system

### Eksisterende og relevante tiltak med beskrivelse:

#### Safety google

Safety google is used to protect the eye from chemical contact/splash etc.

#### Lab coat

Lab coat is used to protect the clothes and skin from contact with the chemicals.

#### Nitrile gloves

Nitrile gloves are used to protect the skin from contact with the chemicals.

**Fume hood**

Working in fume hoods minimize the exposure and inhalation of chemicals.

**Heat resistant gloves and pilers**

Used when handling hot objects.

**Ventilation on oven**

Ventilation on the oven is used to prevent gases evaporating from the solution or sample from entering the room and accumulating. Minimize human exposure to the gases

**Interlock system**

An interlock system on the ferroelectric measurement instruments, that prevents an application of voltage, unless the thin film setup and probes are covered by a lid.



## 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:**

- **Prepare Nb-acid**
  - Eye and skin contact with chemicals
  - Inhalation of chemicals
- **Preparation of solution used for hydrothermal synthesis.**
  - Eye and skin contact with chemicals
  - Inhalation of chemicals
  - Ignition of chemicals
- **Hydrothermal synthesis**
  - Burn
  - High pressure
  - Contact with substrate used in synthesis
- **Standardization of Nb-acid solution**
  - Burn
  - Gas accumulation
- **Post synthesis treatment**
  - Washing and centrifugation
  - Inhalation of powder/dried nanorods.
- **X-ray diffraction**
  - Contact and inhalation of material
  - Operation of instrument
- **SEM imaging**
  - Contact and inhalation of material
  - Operation of instrument
- **AFM**
  - Contact or inhalation of material
- **Mortaring powders**
  - Skin or eye contact with powder
  - Inhalation of powder
- **Preparation of substrate holder**
  - Cut and squeezing of skin
- **Washing of autoclave**
  - Contact with acid
  - Inhalation of acid
  - Contact or inhalation of base
- **Ferroelectric measurements**
  - High voltage

## Detaljert oversikt over farekilder og uønskede hendelser:

## Farekilde: Prepare Nb-acid

## Uønsket hendelse: Eye and skin contact with chemicals

Spills, splashes or other accidents can cause the chemicals to come in contact with the skin or the eyes.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Lite sannsynlig (2)**

*Kommentar:*

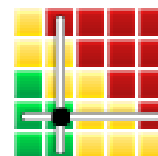
By the use of protective gear, the chance of contact with the chemicals is small.

## Konsekvensområde: Helse

Vurdert konsekvens: **Middels (2)**

*Kommentar:* Only the ammonia solution is noted as hazardous in this process, but this could cause severe burns to skin and eyes.

## Risiko:



## Uønsket hendelse: Inhalation of chemicals

Vapor from the chemicals can be inhaled in the laboratory.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Lite sannsynlig (2)**

*Kommentar:*

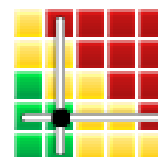
Working in a fume hood (correctly, max 30 cm opening), effectively stops the possibility for inhalation. If the air flow in the fume hood is also controlled before use, the risk of inhalation is very small.

## Konsekvensområde: Helse

Vurdert konsekvens: **Middels (2)**

*Kommentar:* Inhalation of ammonia can cause irritation of airways, but small amounts of the substance are used.

## Risiko:



## Farekilde: Preparation of solution used for hydrothermal synthesis.

Mixing Nb-acid with Ba- and Sr-nitrate and transferring to Teflon cup and inserting this into the autoclave.

### Uønsket hendelse: Eye and skin contact with chemicals

Spills, splashes or other accidents can cause the chemicals to come in contact with the skin or the eyes.

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

Kommentar:

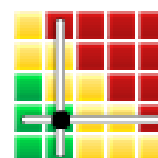
By the use of protective gear, the chance of contact with the chemicals is small.

### Konsekvensområde: Helse

Vurdert konsekvens: **Middels (2)**

Kommentar: Ammonia solution: cause severe burns to skin and eyes.  
Ba-nitrate: Causes severe eye irritation.  
Sr-nitrate: Causes severe eye damage.

**Risiko:**



### Uønsket hendelse: Inhalation of chemicals

Vapor from the chemicals can be inhaled in the laboratory.

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

Kommentar:

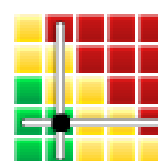
Working in a fume hood (correctly, max 30 cm opening), effectively stops the possibility for inhalation. If the air flow in the fume hood is also controlled before use, the risk of inhalation is very small.

### Konsekvensområde: Helse

Vurdert konsekvens: **Middels (2)**

Kommentar: Inhalation of ammonia can cause irritation of airways, Ba-nitrate is dangerous with inhalation, while Sr-nitrate is dangerous with swallowing. Only small amounts of the substances are used.

**Risiko:**



**Uønsket hendelse: Ignition of chemicals**

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Both Ba- and Sr-nitrate are oxidizing chemicals and ammonia could be flammable.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Lite sannsynlig (2)**

*Kommentar:*

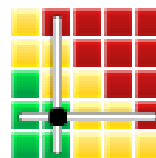
Avoiding having any ignition or heat sources nearby when working with the mixing will lower the risk.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Middels (2)**

*Kommentar:* Barium and strontium nitrate are oxidizing materials but only smaller amounts of chemicals are used.

**Risiko:**



**Farekilde: Hydrothermal synthesis**

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**Uønsket hendelse: Burn**

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Direct skin contact with the hot surfaces that are present in this synthesis method could cause a burn.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Lite sannsynlig (2)**

*Kommentar:*

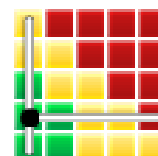
The autoclave will be placed and removed from the oven at room temperature, and the oven will be closed during the entire heating procedure. Giving a low probability of contact with a hot surface.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Liten (1)**

*Kommentar:* The temperature used is 250 C, so only light burn can be expected.

**Risiko:**

**Uønsket hendelse: High pressure**

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The heating of the autoclave will cause the water and ammonia in the solution to evaporate and create a higher pressure in the autoclave. If this pressure gets too high the autoclave can break and cause a spill of the chemicals.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Svært lite sannsynlig (1)**

*Kommentar:*

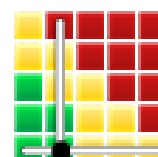
The autoclaves are built for handling higher pressure. Following the proper use of the autoclave and not exceeding the given maximal pressure and temperature gives a low risk of a breakdown. The maximal pressure is about 50 bar.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Middels (2)**

*Kommentar:* Ammonia, Ba, and Sr are present in the solution and causes harm with skin or eye contact and inhalation.

**Risiko:**

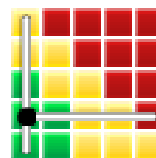


**Uønsket hendelse: Contact with substrate used in synthesis**

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

The use of nitrile gloves makes direct skin contact unlikely.

**Konsekvensområde: Helse***Vurdert konsekvens:* **Liten (1)***Kommentar:* Neither magnesium oxide or strontium titanate are classified as dangerous chemicals.**Risiko:**

**Farekilde: Standardization of Nb-acid solution**

Determine the concentration of Nb in the solution by heat treatment in calcination furnace and weighting of the dry oxide.

**Uønsket hendelse: Burn**

The solution is heated to elevated temperatures in a crucible.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Lite sannsynlig (2)**

*Kommentar:*

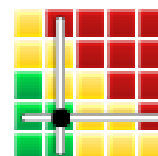
Use gloves and pliers to remove crucibles if hot, gives a low probability.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Middels (2)**

*Kommentar:* The crucible will be handled at 400 C which could give larger burn if contact is made with the skin.

**Risiko:**

**Uønsket hendelse: Gas accumulation**

During the heat treatment, the ammonia solution will evaporate from the Nb-acid and have the potential to accumulate if not proper ventilation is used.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Lite sannsynlig (2)**

*Kommentar:*

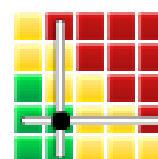
A small amount of solution is used, 10-20 mL and the use of ventilation in the oven will minimize the risk of accumulation and human exposure to the gas.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Middels (2)**

*Kommentar:* A weak ammonia solution is used in this stage 1%, but it could still be irritating for skin, eyes and respiration system.

**Risiko:**



**Farekilde: Post synthesis treatment**

The solution will be centrifuged and the end product will be dried for further characterization. There will be made both a powder of nanorods and growth of nanorods on a substrate in this project.

**Uønsket hendelse: Washing and centrifugation**

Contact with the solution can be made

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Lite sannsynlig (2)**

*Kommentar:*

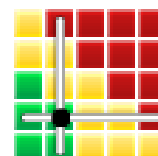
By the use of protective gear, the chance of contact with the chemicals is small. Use double nitrile gloves and clean the surfaces after work thoroughly.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Middels (2)**

*Kommentar:* Ammonia solution causes severe burns to skin and eyes. SBN is not known to be hazardous but as the material is nanosized this could have unknown effect on the human body.

**Risiko:**

**Uønsket hendelse: Inhalation of powder/dried nanorods.**

Avoid inhalation of dust and aerosol  
Avoid contact with the powder

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Lite sannsynlig (2)**

*Kommentar:*

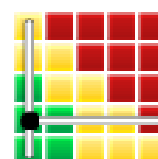
Working in a fume hood (correctly, max 30 cm opening), effectively stops the possibility for inhalation. If the air flow in the fume hood is also controlled before use, the risk of inhalation is very small.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Liten (1)**

*Kommentar:* The ammonia solution is removed and SBN is not known to be hazardous but as the material is nanosized this could have unknown effect on the human body.

**Risiko:**





**Farekilde: X-ray diffraction**

The sample will be characterized by XRD.

**Uønsket hendelse: Contact and inhalation of material**

The powder or loss nanorods could come in contact with the skin or could be inhaled in the laboratory.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Sannsynlig (3)**

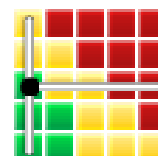
*Kommentar:*

As the sample need to be transported and inserted into the equipment, the probability for exposure is increased, but transport in a sealed container and the use of gloves and glasses when handling will lower the risk.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Liten (1)**

*Kommentar:* SBN is not known to be hazardous but as the material is nanosized this could have unknown effect on the human body.

**Risiko:****Uønsket hendelse: Operation of instrument**

There is a risk of exposure to radiation.

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

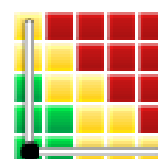
*Kommentar:*

Training on how to use equipment and following of the procedure will give a low risk.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Liten (1)**

*Kommentar:* The X-ray radiation is confined to the instrument, cannot escape.

**Risiko:**

**Farekilde: SEM imaging**

The sample will be characterized by SEM.

**Uønsket hendelse: Contact and inhalation of material**

The powder or loss nanorods could come in contact with the skin or could be inhaled in the laboratory.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Sannsynlig (3)**

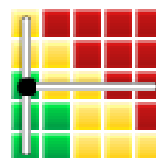
*Kommentar:*

As the sample need to be transported and inserted into the equipment, the probability for exposure is increased, but transport in a sealed container and the use of gloves and glasses when handling will lower the risk.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Liten (1)**

*Kommentar:* SBN is not known to be hazardous but as the material is nanosized this could have unknown effect on the human body.

**Risiko:****Uønsket hendelse: Operation of instrument**

High voltages are used in SEM imaging which is a potential health threat.

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

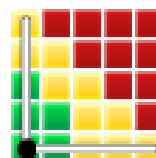
*Kommentar:*

Training on how to use equipment and following of the procedure will give a low risk.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Liten (1)**

*Kommentar:* The high voltage cannot be reached.

**Risiko:**

**Farekilde: AFM**

The sample will be characterized by PFM.

**Uønsket hendelse: Contact or inhalation of material**

The powder or loss nanorods could come in contact with the skin or could be inhaled in the laboratory.

Sannsynlighet for hendelsen (felles for alle konsekvensområder): **Sannsynlig (3)**

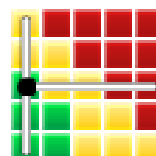
*Kommentar:*

As the sample need to be transported and inserted into the equipment, the probability for exposure is increased, but transport in a sealed container and the use of gloves and glasses when handling will lower the risk.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Liten (1)**

*Kommentar:* SBN is not known to be hazardous but as the material is nanosized this could have unknown effect on the human body.

**Risiko:**

**Farekilde: Mortaring powders**

Some powder need to be crushed in a mortar

**Uønsket hendelse: Skin or eye contact with powder**

The powder can come in contact with the skin or even the eye.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Lite sannsynlig (2)**

*Kommentar:*

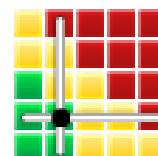
By the use of protective gear, the chance of contact with the chemicals is small.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Middels (2)**

*Kommentar:* Ammonia solution: cause severe burns to skin and eyes.  
Ba-nitrate: Causes severe eye irritation.  
Sr-nitrate: Causes severe eye damage.  
Ba is also a heavy metal.

**Risiko:**

**Uønsket hendelse: Inhalation of powder**

The powder can mix with air and be inhaled during the laboratory work.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Lite sannsynlig (2)**

*Kommentar:*

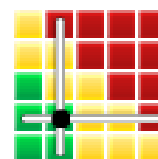
Working in a fume hood (correctly, max 30 cm opening), effectively stops the possibility for inhalation. If the air flow in the fume hood is also controlled before use, the risk of inhalation is very small.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Middels (2)**

*Kommentar:* Ba-nitrate is dangerous with inhalation and is a heavy metal, while Sr-nitrate is dangerous with swallowing. Only small amounts of the substances are used.

**Risiko:**



**Farekilde: Preparation of substrate holder**

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The substrate holder is cut from Teflon by hand using a drill and knife.

**Uønsket hendelse: Cut and squeezing of skin**

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The use of a knife and an automated drill could result in cuts or squeezing of the skin in addition to other small injuries caused by handling tools.

*Sannsynlighet for hendelsen (felles for alle konsekvensområder):* **Sannsynlig (3)**

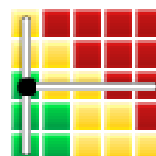
*Kommentar:*

By using basic knowledge about tool handling, injuries are not particularly likely.

**Konsekvensområde: Helse**

*Vurdert konsekvens:* **Liten (1)**

*Kommentar:* Only small tools are used and only a minor injury is therefore expected.

**Risiko:**

**Farekilde: Washing of autoclave**

Use acid to wash the autoclave, concentrated HNO<sub>3</sub> will be diluted and then be used for the washing. The risk evaluation is concerning the most dangerous step, diluting the concentrated acid.

**Uønsket hendelse: Contact with acid**  
.....

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Svært lite sannsynlig (1)**

*Kommentar:*

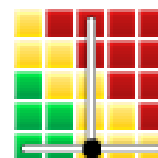
Use of protective acid gloves (long sleeves) and work in a fume hood with class coverage makes the risk of contact with the chemical very low.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Stor (3)**

*Kommentar:* Concentrated nitric acid, etches the skin.

**Risiko:**

**Uønsket hendelse: Inhalation of acid**  
.....

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Svært lite sannsynlig (1)**

*Kommentar:*

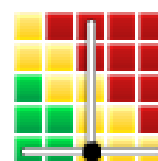
Use of fume hood makes the probability very low for inhalation of chemical.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Stor (3)**

*Kommentar:* Concentrated nitric acid, could etch the respiratory system

**Risiko:**



**Uønsket hendelse: Contact or inhalation of base**

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NaOH will also be used to wash the autoclave.

Sannsynlighet for hendelsen (felles for alle konsekvensområder):

**Lite sannsynlig (2)**

*Kommentar:*

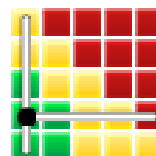
Use of gloves and ventilation.

**Konsekvensområde: Helse**

Vurdert konsekvens: **Liten (1)**

*Kommentar:* Can irritate skin and respiratory system.

**Risiko:**



**Farekilde: Ferroelectric measuremets**

Characterization of the ferroelectric properties of thin films

**Uønsket hendelse: High voltage**

A voltage up to 200 V can be applied in the instrument.

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

*Kommentar:*

The interlock system gives a very low probability of contact with the high voltage.

**Konsekvensområde: Helse**

*Vurdert konsekvens:* **Middels (2)**

*Kommentar:* 200 V powder source is used.

**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