

# NB-323: Modification of EA-354 (SrTiO<sub>3</sub>:Al, upscaled batch) with Rh, Cr oxide cocatalyst (0.2 wt%)

Date: 2025-10-27

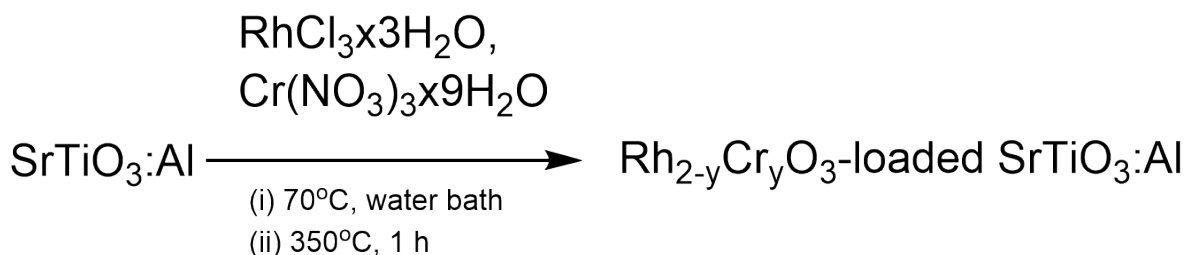
Tags: NB synthesis Furnace Muffle  
Furnace SrTiO<sub>3</sub> RhCl<sub>3</sub> Osterloh  
RhxCrO<sub>3</sub> Al:SrTiO<sub>3</sub> RhCrO<sub>3</sub>:Al:SrTiO<sub>3</sub>  
Cr(NO<sub>3</sub>)<sub>3</sub>

Category: SrTiO<sub>3</sub>

Status: Done

Created by: Nadzeya Brezhneva

## Reaction scheme/sample structure



ChemDraw File (linked): [NB-189-RhCr-oxide-loaded-Al-SrTiO3.cdxml](#)

## Literature/reference experiments

Literature	<a href="https://doi.org/10.1039/C9EE00310J">https://doi.org/10.1039/C9EE00310J</a>
Reproduction	/
Similar experiments	<a href="#">SrTiO<sub>3</sub> - NB-321: Modification of EA-354 (SrTiO<sub>3</sub>:Al, upscaled batch) with Rh, Cr oxide cocatalyst (0.05 wt%)</a> <a href="#">SrTiO<sub>3</sub> - EA-358: Modification of Al:SrTiO<sub>3</sub> (EA-354) via deposition of Rh, Cr oxide cocatalyst, 350°C, 1h, Upscaling (3.33x)</a> <a href="#">SrTiO<sub>3</sub> - EA-359: Modification of Al:SrTiO<sub>3</sub> (EA-354) via deposition of Rh, Cr oxide cocatalyst, 350°C, 1h</a>

## Reagents

Name	CAS Number / Experiment Number	Inventory number	Amount	Equivalents	Mass <sub>theo</sub> [mg]	Mass <sub>exp</sub> [mg]	Molar mass [g/mol]	Density [g/ml]	Volume [ul]
Al:SrTiO <sub>3</sub> (EA-354)	<a href="#">SrTiO<sub>3</sub> - EA-354: Preparation of Al:SrTiO<sub>3</sub> (using EA-352-SrTiO<sub>3</sub>-molten-salt and SrCl<sub>2</sub> as flux) at 1000°C, 10 h, Osterloh route, upscaling x15, filtration with PVDF</a>	/	0.81 mmol	1	150	150.57	183.49	/	/
9.87 mM RhCl <sub>3</sub> solution (EA-357)	#EA-357	/	2.92 umol	0.2 wt% Rh <sup>[a]</sup>	/	300	209.26	/	300
28.8 mM Cr(NO <sub>3</sub> ) <sub>3</sub> solution (EA-357)	#EA-357	/	5.76 umol	0.2 wt% Cr <sup>[b]</sup>	/	200	238.011	/	200
milli-Q water	/	/	0.19 mol	/	/	/	18	0.998	3500 <sup>[c]</sup>

[a] - Rh content in the final product

[b] - Cr content in the final product

[c] - for suspension preparation

## Excel sheet for reagent calculation

[NB-323-calculations.xlsx](#)

## Furnace Parameters

Equipment - Muffle furnace Nabertherm LT 15/11/P330 (AWZ 304 lab)

Protocol - Muffle furnace Nabertherm GmbH LT 15/11/P330 (Lab AWZ 304)

## Temperature/time parameters

Used zone or charge sensor	Zone
Used delayed start	/
Used automatic/manual/extended holdback	Automatic
The temperature band entered for manual/extended holdback (°C)	/
End time [min], relative to start of program	/

## Segments

	Target Temperature (°C)	Duration (h)	Rate (°C/h)	Temperature band (°C)	Description of the segment	Observations
First segment	350	0:33	600	/	Increase	/
Second segment	350	1:00	/	/	Hold	/
End segment	0	/	/	/	Natural cooling down	/

## Procedure/observations

For transfer of precise liquid amount, Eppendorf pipettes were used (for 10 - 100  $\mu\text{L}$ : 100  $\mu\text{L}$  Eppendorf, above 100  $\mu\text{L}$ : 1000  $\mu\text{L}$  Eppendorf).

Date	Time	Step	Observations	Pictures
27.10.2025	21:45	Weighing <b>EA-354</b> in a 25 mL Schott glass beaker.	Slightly creamy solid.	/
	ca. 22:00	Placing the glass stirring bar (8 mm) inside the beaker.	/	/
	22:30	Addition of 3500 $\mu\text{L}$ of $\text{H}_2\text{O}$ ( $3 \times 1000 + 500$ ) to the beaker.	Creamy, slightly pinkish suspension.	/
	ca. 22:35	Placing the beaker with the suspension into the water bath (currently, at room T).	/	<a href="#">20251027_223807-after addition of water.jpg</a>
	22:35	Switching the stirring (400 rpm).	/	/
	22:38	Fast addition of 300 $\mu\text{L}$ of 9.87 mM $\text{RhCl}_3$ solution to a beaker under stirring.	/	/
	22:41	Fast addition of 200 $\mu\text{L}$ of 28.9 mM $\text{Cr}(\text{NO}_3)_3$ solution to a beaker under stirring.	/	/
	22:45	Switching the heating mode on (70 $^\circ\text{C}$ , precise mode).	/	<a href="#">20251027_224515-start of heating.jpg</a>
	22:45-0:24	Evaporating of water under constant stirring at 70 $^\circ\text{C}$ .	/	

28.10.2025	0:24	Stop stirring, since all water has been evaporated, removing the stirring bar from the beaker.	A bit more intense pink colour on the edges (walls of the beaker), but in general solid seems quite homogeneous	<a href="#">20251028_002435-after evaporation of water.jpg</a>
	0:30-40	Transfer of the solid to the quartz crucible using Smartspatula, covering the crucible with lid and Al foil before further use.	More intense pink colour than in the case of the sample <a href="#">SrTiO<sub>3</sub> - NB-321: Modification of EA-354 (SrTiO<sub>3</sub>:Al, upscaled batch)</a> with Rh, Cr oxide cocatalyst (0.05 wt%) with lower RhCr content	<a href="#">20251028_004253-transferred solid to the crucible before calcination.jpg</a>
	ca. 10:30	Loading the crucible with the dried sample (together with the crucible with the sample <a href="#">SrTiO<sub>3</sub> - NB-321: Modification of EA-354 (SrTiO<sub>3</sub>:Al, upscaled batch)</a> with Rh, Cr oxide cocatalyst (0.05 wt%)) in a muffle furnace <a href="#">Equipment - Muffle furnace Nabertherm LT 15/11/P330 (AWZ 304 lab)</a> .	/	<a href="#">20251028_103723-before calcination.jpg</a> <a href="#">20251028_103806-crucibles inside the furnace.jpg</a>
	10:40	Start of the program (350 °C, 1 h, 10 °/min).	/	<a href="#">20251028_104132-start of the calcination program.jpg</a>
	19:20	Removal of the sample from the furnace.	T = 163 °C when opening the lid Grey solid (more intense grey colour in comparison with <a href="#">SrTiO<sub>3</sub> - NB-321: Modification of EA-354 (SrTiO<sub>3</sub>:Al, upscaled batch)</a> with Rh, Cr oxide cocatalyst (0.05 wt%)).	<a href="#">20251028_192731-after calcination-top 0.05 wt RhCr-bottom 0.2 wt RhCr.jpg</a>
	20:40	Collecting the sample from the beaker, transfer to a 4 mL vial with a screw cap, weighing. m = 140.76 mg	<b>NB-323-0.2 wt% Rh,Cr-oxide loaded Al:SrTiO<sub>3</sub></b> Grey solid.	<a href="#">20251028_204029-final product.jpg</a>

## Product characterization

Sample	Mass [mg]	Purity	Mass <sub>pure</sub> [mg]	Amount [mol]	Yield [%]	Description	Image	Storage location
<b>NB-323-0.2 wt% Rh,Cr-oxide loaded Al:SrTiO<sub>3</sub></b>	140.76	/	/	/	93.48	Grey solid.	<a href="#">20251028_204029-final product.jpg</a>	Lab E004 (CEEC II), SSC cabinet (SrTiO <sub>3</sub> -6 container)

# Results

Modification of Al:SrTiO<sub>3</sub> sample (**EA-354**, upscaled batch) with Rh, Cr oxide cocatalyst (0.2 wt% Rh and Cr in final product) was performed. The final product (**NB-323-0.2 wt% Rh,Cr-oxide loaded Al:SrTiO<sub>3</sub>**) is represented with grey solid, m = 140.76 mg, yield 93.48 %.

## Linked experiments

SrTiO<sub>3</sub> - [EA-354: Preparation of Al:SrTiO<sub>3</sub> \(using EA-352-SrTiO<sub>3</sub>-molten-salt and SrCl<sub>2</sub> as flux\) at 1000°C, 10 h, Osterloh route , upscaling x15, filtration with PVDF](#)

SrTiO<sub>3</sub> - [EA-359: Modification of Al:SrTiO<sub>3</sub> \(EA-354\) via deposition of Rh, Cr oxide co-catalyst, 350°C, 1h](#)

SrTiO<sub>3</sub> - [NB-321: Modification of EA-354 \(SrTiO<sub>3</sub>:Al, upscaled batch\) with Rh, Cr oxide cocatalyst \(0.05 wt%\)](#)

## Linked resources

Equipment - [Muffelofen L3/11/P320, Nabertherm GmbH, Lab 106, CEEC I, \(Matilda\)](#)

Equipment - [Muffle furnace Nabertherm LT 15/11/P330 \(AWZ 304 lab\)](#)

Protocol - [Heat treatment using Muffelofen L3/11/P320, Nabertherm GmbH, Lab 106, CEEC I](#)

Protocol - [Muffle furnace Nabertherm GmbH LT 15/11/P330 \(Lab AWZ 304\)](#)

## Attached files

NB-323-calculations.xlsx

sha256: a3c06b7fe2647f19025afeff813b29d410f563300b88bda29938dbb45226e492

20251028\_204029-final product.jpg

sha256: be1e0788fb8f5f62b9db8dbcdd31bebb9d06a6701ae4372f44095c6e12dff195



20251028\_192731-after calcination-top 0.05 wt RhCr-bottom 0.2 wt RhCr.jpg

sha256: 4f01f07077e18c2cfae555642697dbf6ce5201b360e901103e040556508d8e73



20251028\_002435-after evaporation of water.jpg

sha256: 6659d46411b69d279ac98cfa1aef1a23e4da086d329611ff52d123d7e5b7cc67



20251027\_224515-start of heating.jpg

sha256: 105dff06183db882704a90cb491e2412d42f45119a759c9de05689c72df9ec3e



20251027\_223807-after addition of water.jpg

sha256: fa65dd2f3907a7a12398989317a7c22ae71cf30b815f0a01a10c6c5f12e33922



20251028\_103723-before calcination.jpg

sha256: ebcc76b2879f7111363876d90b734899331703ddacdba714dbf9dc6270fa50df



20251028\_103806-crucibles inside the furnace.jpg

sha256: dc978cb64016b945fe874a679a8b1572618ee806ca3c1d5e65e300ab39836e8a



20251028\_104132-start of the calcination program.jpg

sha256: e0d01050067f72de0367930d55e595be053c63016e421032e8b04b13483824a7



20251028\_004253-transferred solid to the crucible before calcination.jpg  
sha256: 6f0011e043ffe3c862b9f690c0bc896472b4a613a53369a73ebf95b1311e7686



Unique eLabID: 20251027-2483ba6e778657c8c40727e9a53d8163d203a4e9  
Link: <https://elab.water-splitting.org/experiments.php?mode=view&id=3265>