SUPPLEMENTARY INFORMATION

Bifunctional Na-Ru on gamma-alumina for CO2 capture from air and conversion to CH4: impact of regeneration method and supporting on monolithic contactors

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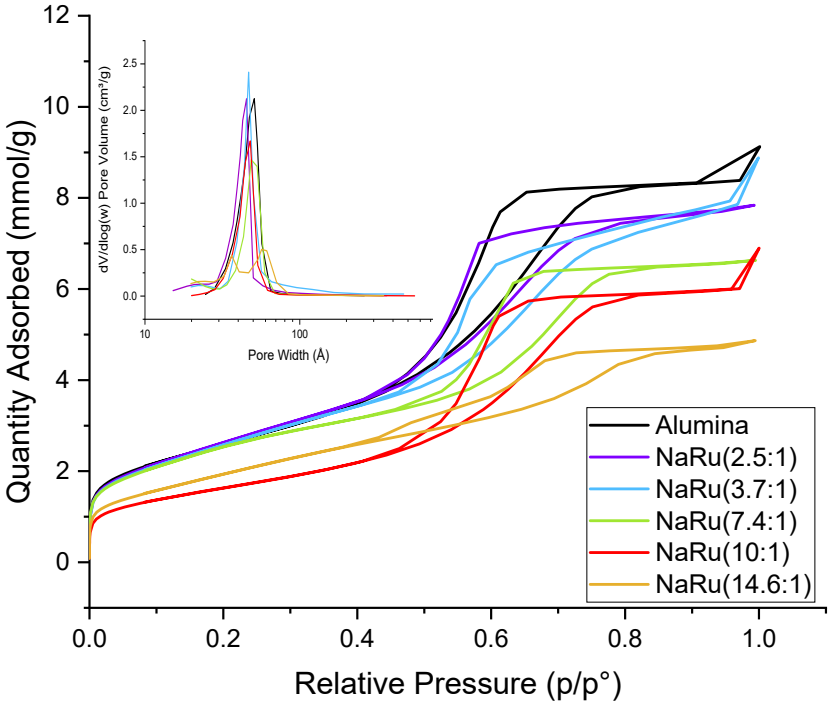
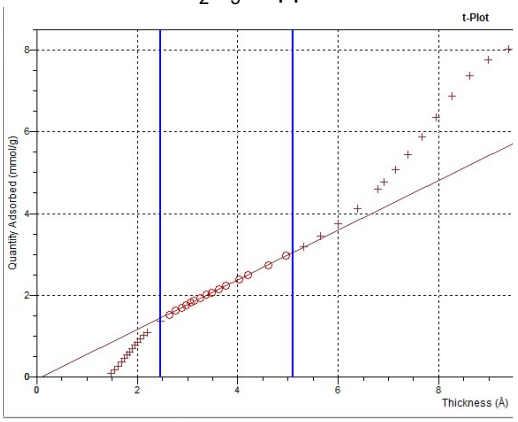


Figure S1. N_2 adsorption isotherms and pore size distribution (inset) for the different Na loadings

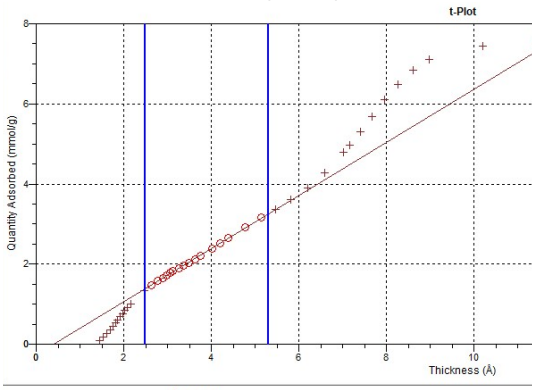
Al_2O_3 support



Summary

Micropore volume:	-0.001892 cm³/g
Micropore area:	*
External surface area:	210.8306 m²/g
Slope:	0.608104 ± 0.004027 mmol/g·Å
Y-intercept:	-0.054583 ± 0.014411 mmol/g
Correlation coefficient:	0.999715
Surface area correction factor:	1.000
Density conversion factor:	0.0015468
Total surface area (BET):	210.1094 m²/g
Thickness range:	2.4659 Å to 5.1002 Å
Thickness equation:	Harkins and Jura

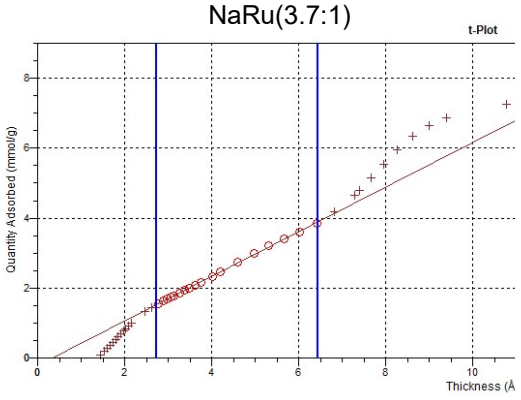
NaRu(2.5:1)



Summary

Micropore volume:	-0.009208 cm³/g
Micropore area:	*
External surface area:	229.8955 m²/g
Slope:	0.663094 ± 0.003627 mmol/g·Å
Y-intercept:	-0.265579 ± 0.013283 mmol/g
Correlation coefficient:	0.999791
Surface area correction factor:	1.000
Density conversion factor:	0.0015468
Total surface area (BET):	217.1054 m²/g
Thickness range:	2.4930 Å to 5.3028 Å
Thickness equation:	Harkins and Jura

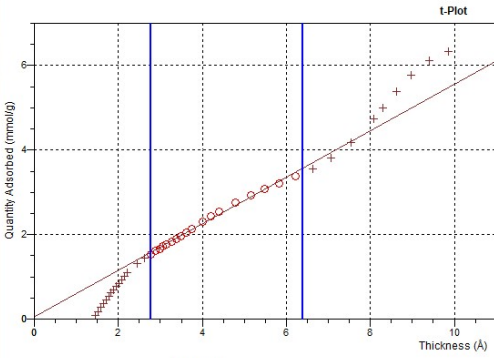
NaRu(3.7:1)



Summary

Micropore volume:	-0.007559 cm³/g
Micropore area:	*
External surface area:	221.2888 m²/g
Slope:	0.638269 ± 0.003489 mmol/g·Å
Y-intercept:	-0.218037 ± 0.014774 mmol/g
Correlation coefficient:	0.999761
Surface area correction factor:	1.000
Density conversion factor:	0.0015468
Total surface area (BET):	213.1066 m²/g
Thickness range:	2.7319 Å to 6.4410 Å
Thickness equation:	Harkins and Jura

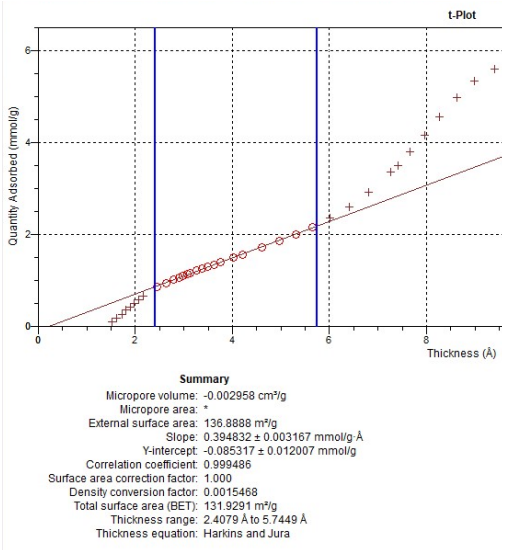
NaRu(7.4:1)



Summary

Micropore volume:	0.001868 cm³/g
Micropore area:	15.4169 m²/g
External surface area:	190.7954 m²/g
Slope:	0.550316 ± 0.010883 mmol/g·Å
Y-intercept:	0.053882 ± 0.045216 mmol/g
Correlation coefficient:	0.996886
Surface area correction factor:	1.000
Density conversion factor:	0.0015468
Total surface area (BET):	206.2123 m²/g
Thickness range:	2.7703 Å to 6.3922 Å
Thickness equation:	Harkins and Jura

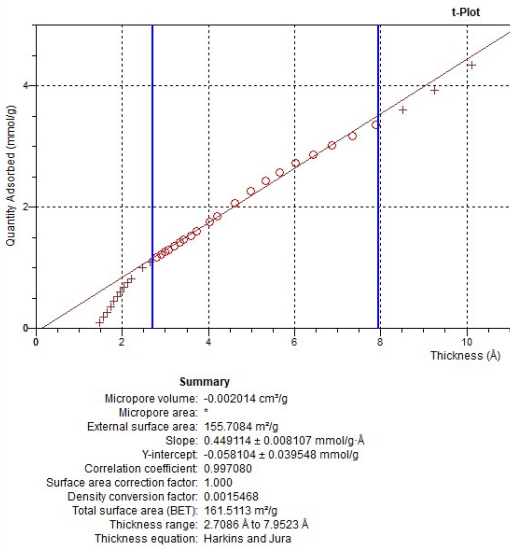
NaRu(10:1)



Summary

Micropore volume:	-0.002958 cm³/g
Micropore area:	*
External surface area:	136.8888 m²/g
Slope:	0.394832 ± 0.003167 mmol/g·Å
Y-intercept:	-0.085317 ± 0.012007 mmol/g
Correlation coefficient:	0.999486
Surface area correction factor:	1.000
Density conversion factor:	0.0015468
Total surface area (BET):	131.9291 m²/g
Thickness range:	2.4079 Å to 5.7449 Å
Thickness equation:	Harkins and Jura

NaRu(14.6:1)

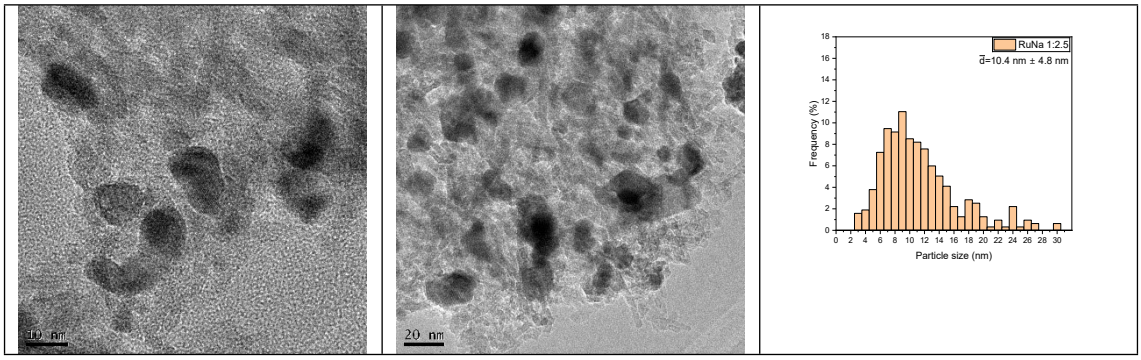


Summary

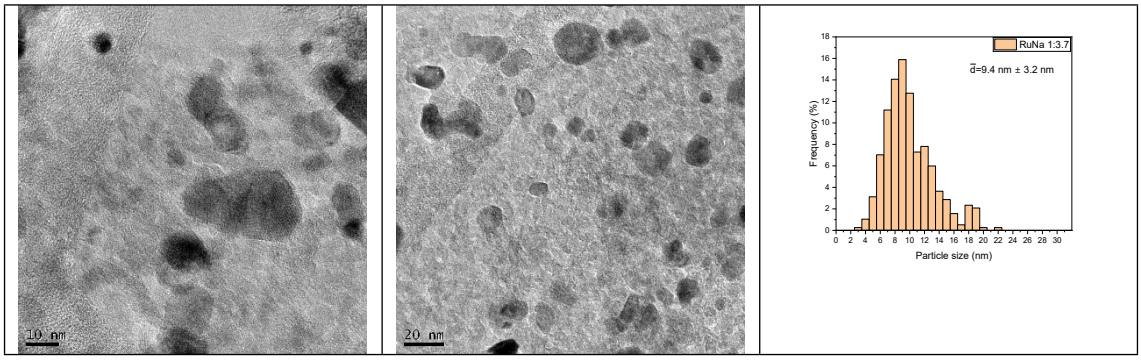
Micropore volume:	-0.002014 cm³/g
Micropore area:	*
External surface area:	155.7084 m²/g
Slope:	0.449114 ± 0.008107 mmol/g·Å
Y-intercept:	-0.058104 ± 0.039548 mmol/g
Correlation coefficient:	0.997080
Surface area correction factor:	1.000
Density conversion factor:	0.0015468
Total surface area (BET):	161.5113 m²/g
Thickness range:	2.7086 Å to 7.9523 Å
Thickness equation:	Harkins and Jura

Figure S2. t-plot analysis of the N2 adsorption isotherm for the different DFMs

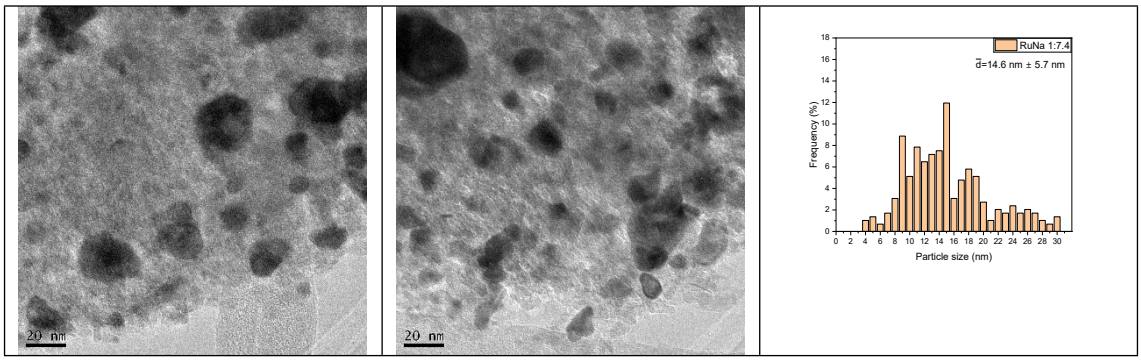
a) **RuNa (1:2.5)**



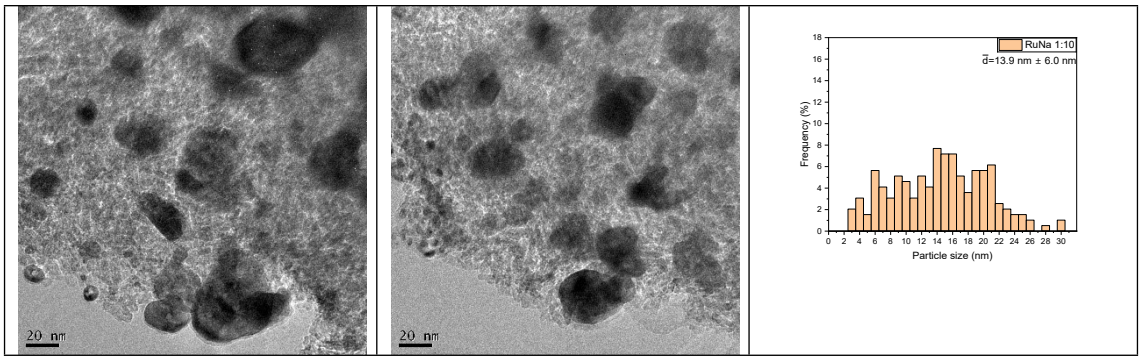
b) **RuNa (1:3.7)**



c) **RuNa (1:7.4)**



d) **RuNa (1:10)**



e) <u>RuNa (1:14.6)</u>

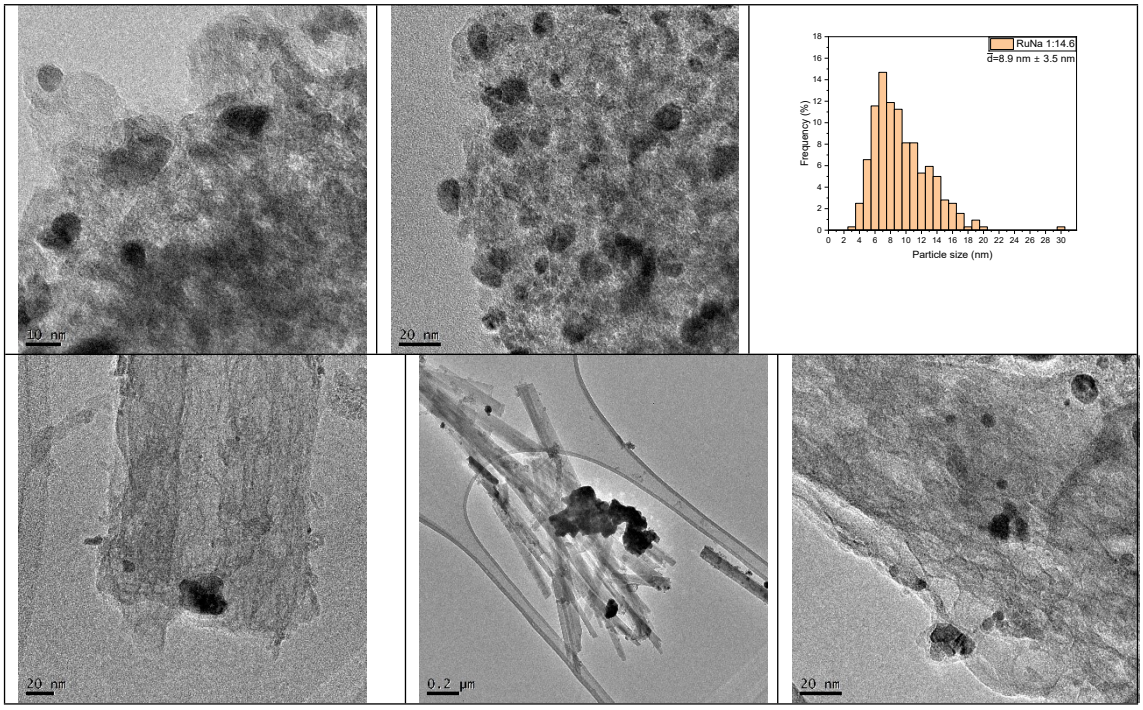
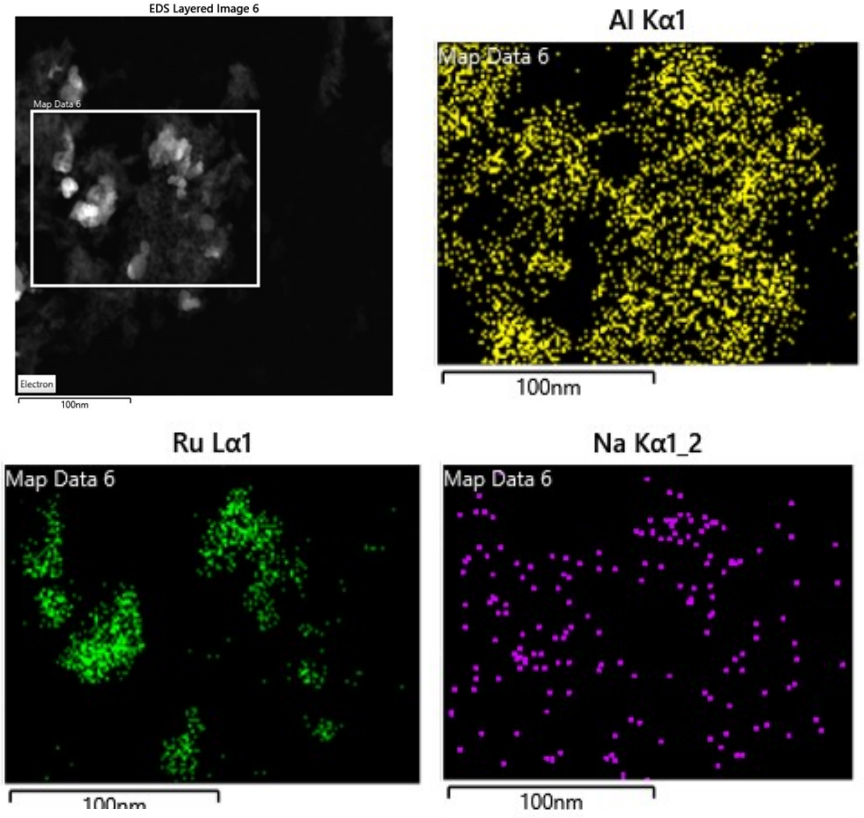


Figure S3. Representative TEM images and histograms for the DFMs with different Na loadings

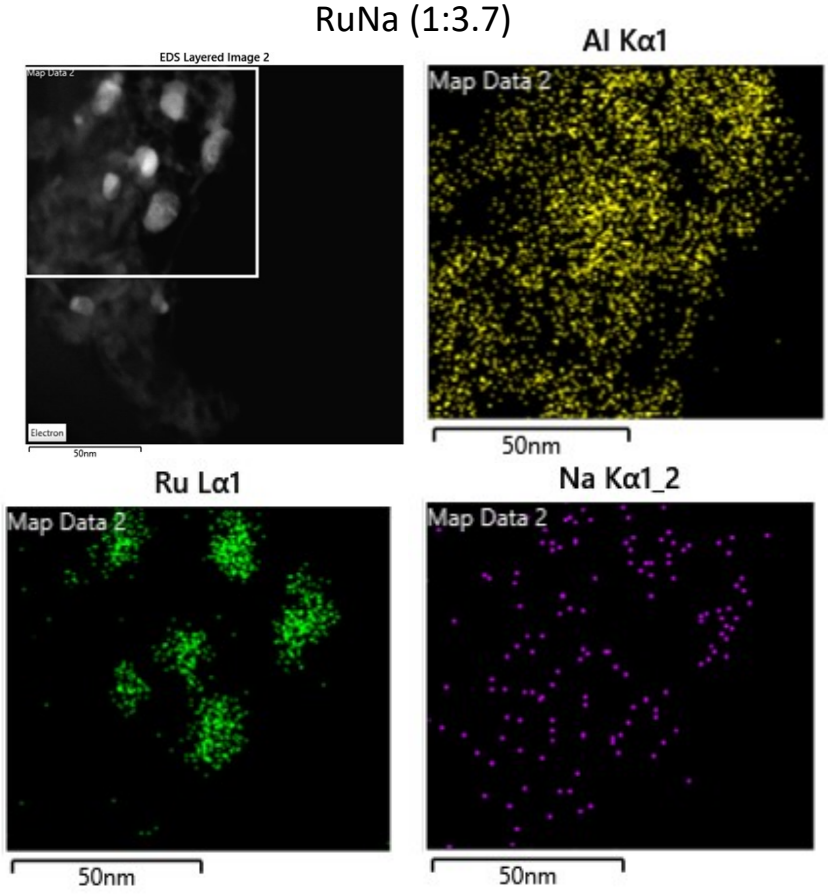
a)

RuNa (1:2.5)


EDS Layered Image 6
Map Data 6
Electron
100nm
Al Kα1
Map Data 6
100nm
Ru Lα1
Map Data 6
100nm
Na Kα1_2
Map Data 6
100nm

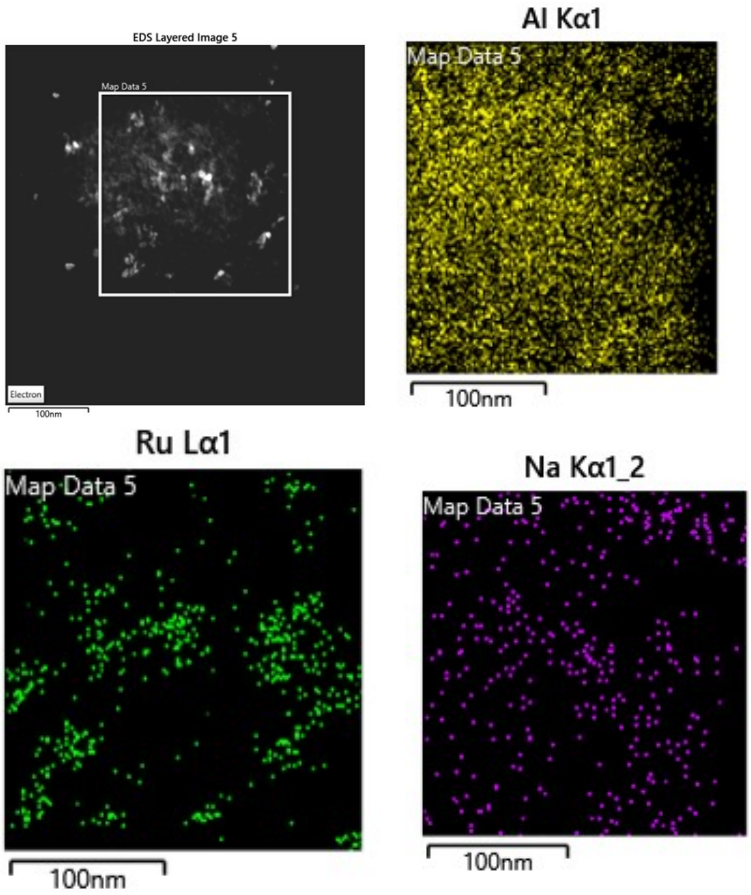
b)

RuNa (1:3.7)


EDS Layered Image 2
Map Data 2
Electron
50nm
Al Kα1
Map Data 2
50nm
Ru Lα1
Map Data 2
50nm
Na Kα1_2
Map Data 2
50nm

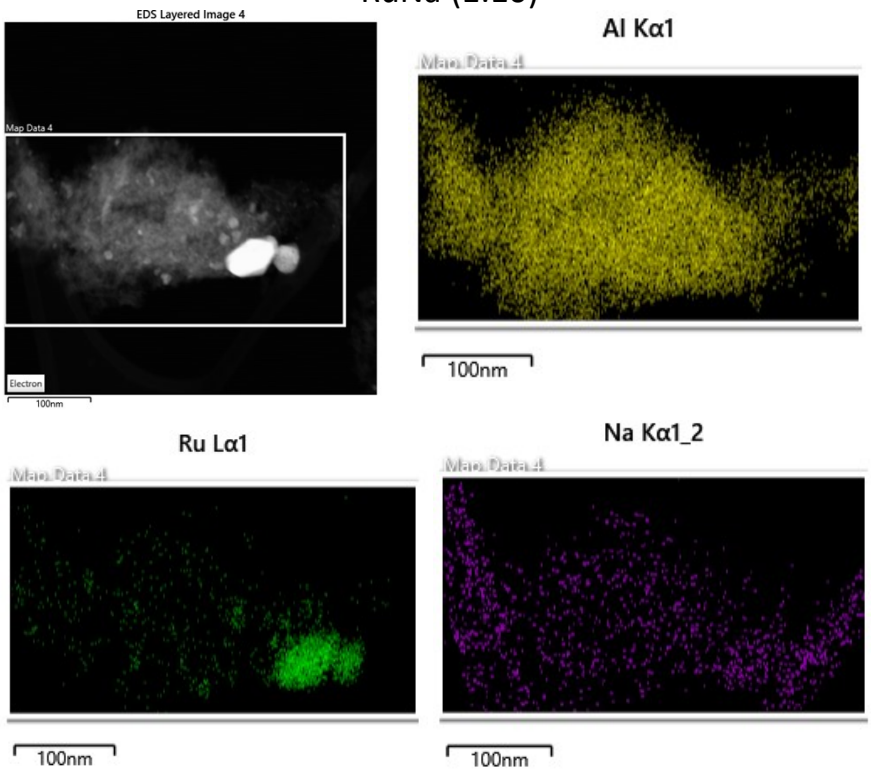
c)

RuNa (1:7.4)



d)

RuNa (1:10)



e)

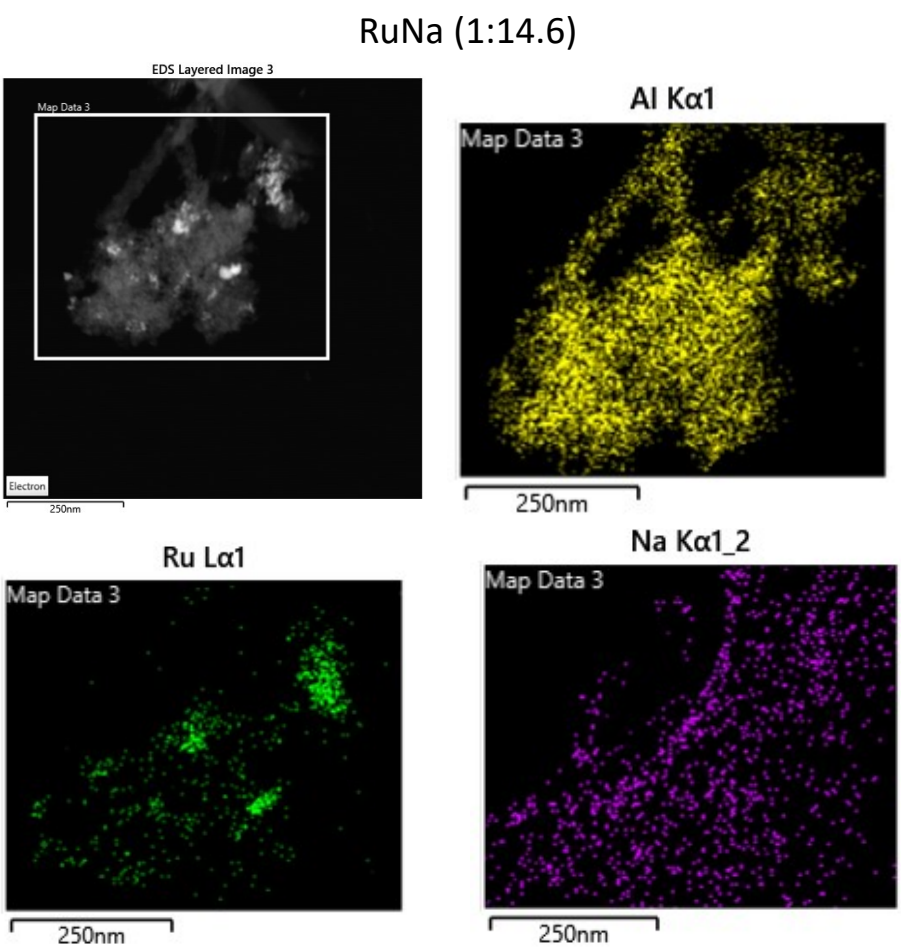


Figure S4. EDS mapping of the DFM with different Na loadings

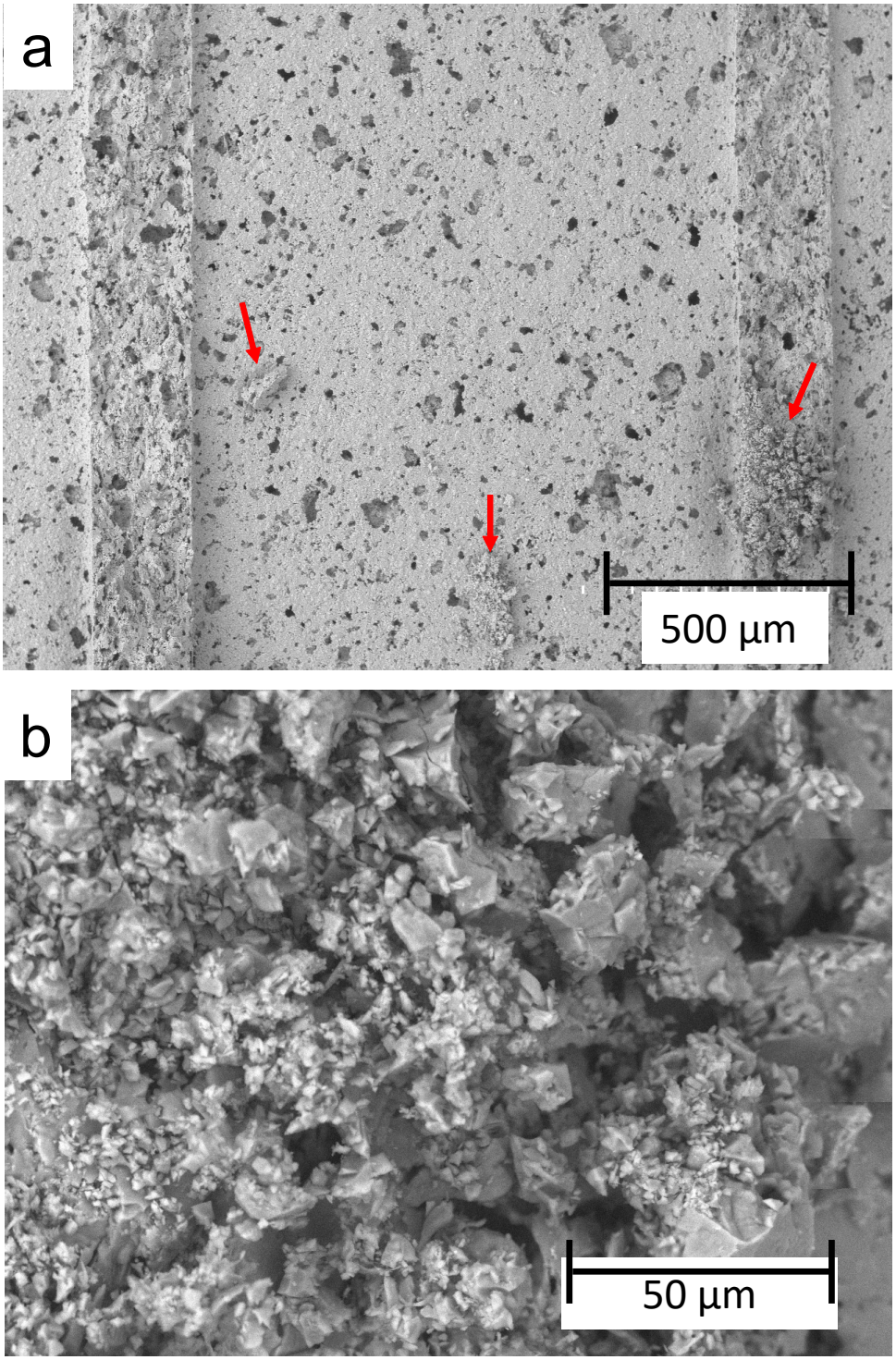


Figure S5. Representative SEM images of a longitudinal cut of a monolith channel coated with Alumina and after impregnation of DFM RuNa (8.3:1): (a) cut of a channel of the monolith**;** (b) magnification with a detail pointed out with red arrow in Figure S5a

Table S1. N_2 physisorption of the pristine cordierite monoliths, after coating with alumina, and after depositing the Na and Ru

Sample	Coating weight loading	Coating volume loading	BET Surface Area	Total pore vol.	Coating Surface Area	Coating pore vol.
	wt%	g/cm^3	m^2 g monol^{-1}	cm^3 g monol^{-1}	m^2 g^{-1}	cm^3 g^{-1}
cordierite	0		0	0	0	0
Al_2O_3 coated cordierite	6.1	0.033	12.9	0.018	215	0.30
DFM RuNa (8.3:1) impregnated Al_2O_3 monolith	6.5	0,035	9.2	0.015	141	0.23