In[ ]:=
```
Charting`$InteractiveHighlighting = False
```
Out[ ]=
```
False
```
In[ ]:=
```
allElemData =
 Take[#[ atomic symbol ] → #[ resistivity ] & /@ EntityList@ elements ELEMENTS //
      Association // Sort // DeleteMissing, {1, -10}] // Dataset
```
Out[ ]=

Th	1.5×10^{-7} m Ω
Re	1.8×10^{-7} m Ω
Pa	1.8×10^{-7} m Ω
V	2.0×10^{-7} m Ω
Tc	2.0×10^{-7} m Ω
Cs	2.0×10^{-7} m Ω
Pb	2.1×10^{-7} m Ω
Yb	2.8×10^{-7} m Ω
U	2.8×10^{-7} m Ω
As	3.0×10^{-7} m Ω
Hf	3.0×10^{-7} m Ω
Ba	3.5×10^{-7} m Ω
Ti	4.0×10^{-7} m Ω
Sb	4.0×10^{-7} m Ω
Zr	4.2×10^{-7} m Ω
Po	4.3×10^{-7} m Ω
Sc	5.5×10^{-7} m Ω
Y	5.6×10^{-7} m Ω
Lu	5.6×10^{-7} m Ω
La	6.1×10^{-7} m Ω

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In[ ]:=
```
(QuantityMagnitude[#]) &@@@ (allElemData // Normal) // KeyValueMap[List, #] &;
% // Export["~/Downloads/elemRests.csv", #] &
```
Out[ ]=
```
~/Downloads/elemRests.csv
```

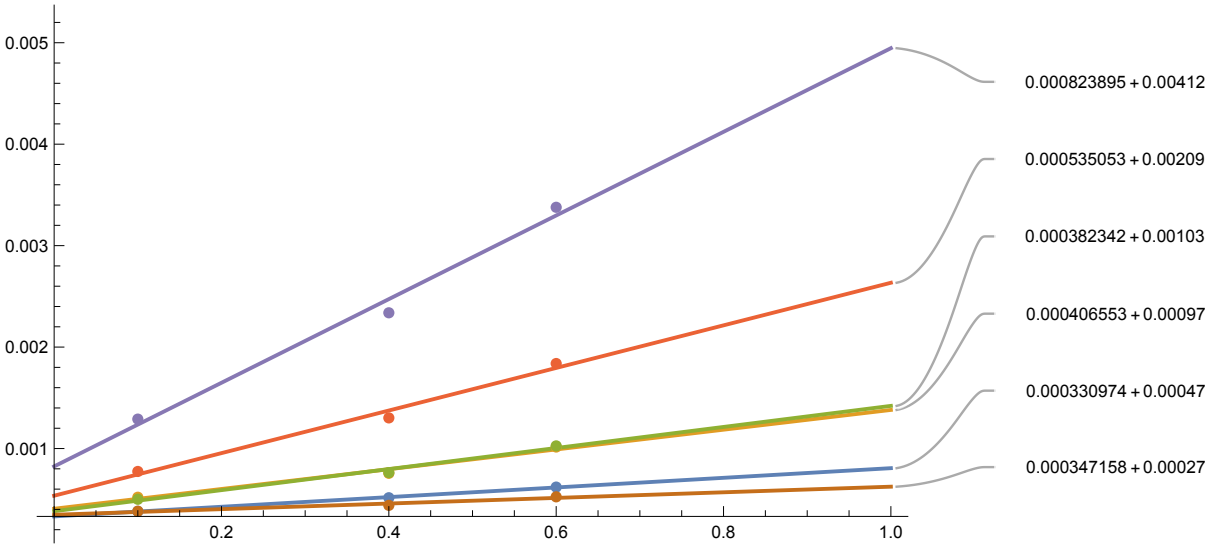
Measurements of the setup

```
In[ ]:= L = 10^-2 {10, 40, 60} & /@ Range[1, 6] // N; (* Lengths of the wires (cm) *)
        r = 1/2 × 10^-3 {1.00, 0.74, 0.71, 0.51, 0.35, 0.52}; (* Radii of the wires (mm) *)
```

2-probes measurement of resistivity

```
In[ ]:= V = 10^-3 {{0.381, 0.515, 0.62}, {0.52, 0.756, 1.015}, {0.5, 0.763, 1.026},
          {0.774, 1.302, 1.838}, {1.29, 2.338, 3.378}, {0.382, 0.44, 0.524}};

In[ ]:= fnfit = LinearModelFit[Transpose[#], x, x] & /@ Transpose[{L, V}];

In[ ]:= Plot[#["BestFit"] & /@ fnfit // Evaluate, {x, 0, 1}, PlotLabels → "Expressions",
          ImageSize → Large] // Show[#, ListPlot[Transpose[#] & /@ Transpose[{L, V}]]] &
```

Out[ ]=




```
In[ ]:= slopes = #["BestFitParameters"][[2]] & /@ fnfit
```

Out[ ]=

```
{0.000475526, 0.000973947, 0.00103816, 0.00209895, 0.00412211, 0.000276842}
```

```
In[ ]:= rests = #1 π #2^2 / 10^-3 &@@@ Transpose[{slopes, r}];
```

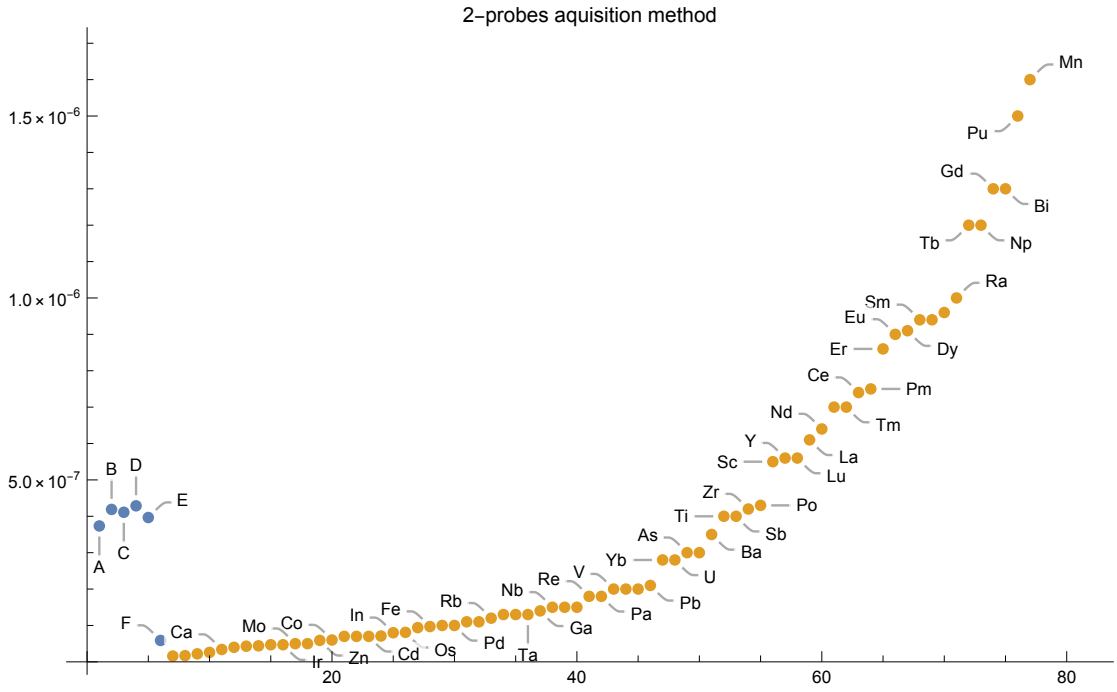
In[ ]:=
```
samples = CharacterRange["A", "F"];
means = #1 → #2 mΩ &@@@ Transpose[{samples, rests}] // Association // Dataset
```

Out[ ]=

A	3.73477×10^{-7} mΩ
B	4.18879×10^{-7} mΩ
C	4.11027×10^{-7} mΩ
D	4.28777×10^{-7} mΩ
E	3.96593×10^{-7} mΩ
F	5.87934×10^{-8} mΩ

In[ ]:=
```
ListPlot[{means, allElemData}, PlotRange → Automatic,
 ImageSize → Large, PlotLabel → "2-probes aquisition method"]
```

Out[ ]=



In[ ]:=
```
Nearest[allElemData // Normal, #, 10] &/@ Values[means] // Normal //
    #1 → #2 &@@@ Transpose[{samples, #}] & // Association // Dataset
```

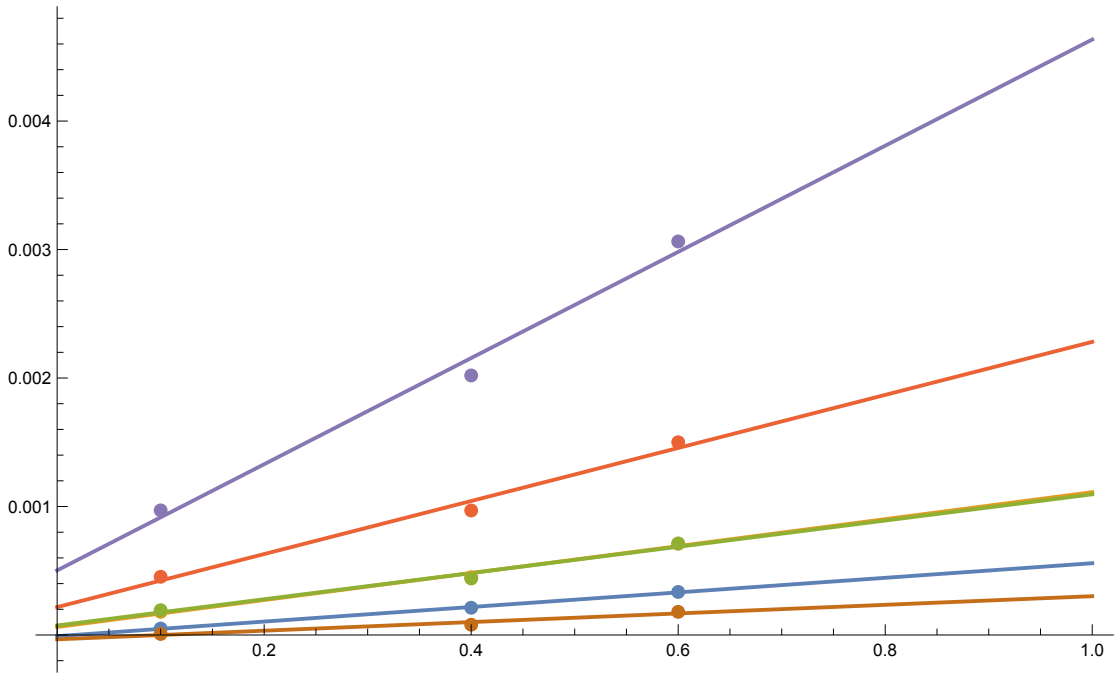
Out[ ]=

A	Ba	Ti	Sb	Zr	Po	As	Hf	Yb	U	Pb
B	Zr	Po	Ti	Sb	Ba	As	Hf	Sc	Yb	U
C	Zr	Ti	Sb	Po	Ba	As	Hf	Yb	U	Sc
D	Po	Zr	Ti	Sb	Ba	Sc	As	Hf	Y	Lu
E	Ti	Sb	Zr	Po	Ba	As	Hf	Yb	U	Sc
F	Zn	Co	Mo	W	K	Ni	Cd	Na	Ir	Ru

4-probes measurement of resistivity

```
In[•]:= V = 10^-3 {{0.05, 0.212, 0.335}, {0.18, 0.45, 0.711}, {0.193, 0.44, 0.712},
          {0.453, 0.969, 1.5}, {0.970, 2.02, 3.063}, {0.008, 0.08, 0.18}};

In[•]:= fnFit = LinearModelFit[Transpose[#], x, x] & /@ Transpose[{L, V}];

In[•]:= Plot[#["BestFit"] & /@ fnFit // Evaluate,
          {x, 0, 1}, ImageSize → Large, PlotRange → All] //
        Show[#, ListPlot[Transpose[#] & /@ Transpose[{L, V}]], PlotRange → All] &
```

Out[•]=



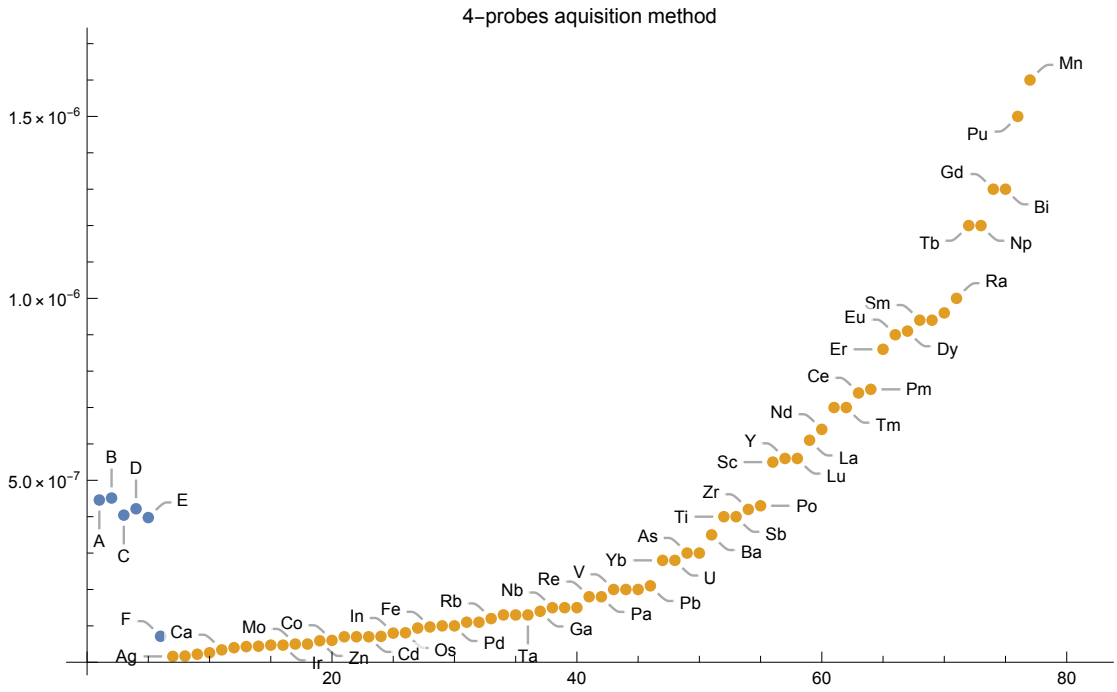

```
In[•]:= slope = #["BestFitParameters"][[2]] & /@ fnFit;

In[•]:= rests = #1 π #2^2 / 10^-3 & @@@ Transpose[{slope, r}];

        means = #1 → #2 mΩ & @@@ Transpose[{samples, rests}] // Association // Dataset
```

Out[•]=

A	4.45817×10^{-7} mΩ
B	4.51249×10^{-7} mΩ
C	4.04254×10^{-7} mΩ
D	4.21735×10^{-7} mΩ
E	3.9753×10^{-7} mΩ
F	7.13122×10^{-8} mΩ

In[ ]:=
```
ListPlot[{means, allElemData}, PlotRange → Automatic,
 ImageSize → Large, PlotLabel → "4-probes aquisition method"]
```

Out[ ]=



In[ ]:=
```
Nearest[allElemData // Normal, #, 10] &/@ Values[means] // Normal //
   #1 → #2 &@@@ Transpose[{samples, #}] & // Association // Dataset
```

Out[ ]=

A	Po	Zr	Ti	Sb	Ba	Sc	Y	Lu	As	Hf
B	Po	Zr	Ti	Sb	Sc	Ba	Y	Lu	As	Hf
C	Ti	Sb	Zr	Po	Ba	As	Hf	Yb	U	Sc
D	Zr	Po	Ti	Sb	Ba	As	Hf	Sc	Y	Lu
E	Ti	Sb	Zr	Po	Ba	As	Hf	Yb	U	Sc
F	Ru	K	Ni	Cd	In	Os	Co	Zn	Mo	W

First part of the experiment with the thermistor

In[ ]:=
```
data = Import[
    "/Users/giovannigravili/Library/Mobile Documents/com~apple~CloudDocs/LM
      MANO/Notebooks/RT/Dati.txt", "Table",
    "HeaderLines" → 6, "FieldSeparators" → "\t", "NumberPoint" → ",",
    CharacterEncoding → "UTF8"] // Dataset // #[All, Range[1, 12]] &;
data = data[All, <|"t (s)" → 1, "V1 (V)" → 2,
  "V2 (V)" → 3, "V3 (V)" → 4, "V4 (V)" → 5, "R1 (Ω)" → 6, "R2 (Ω)" → 7,
  "R3 (Ω)" → 8, "T (K)" → 9, "R1/R1,0" → 10, "R2/R2,0" → 11, "R3/R3,0" → 12|>]
```

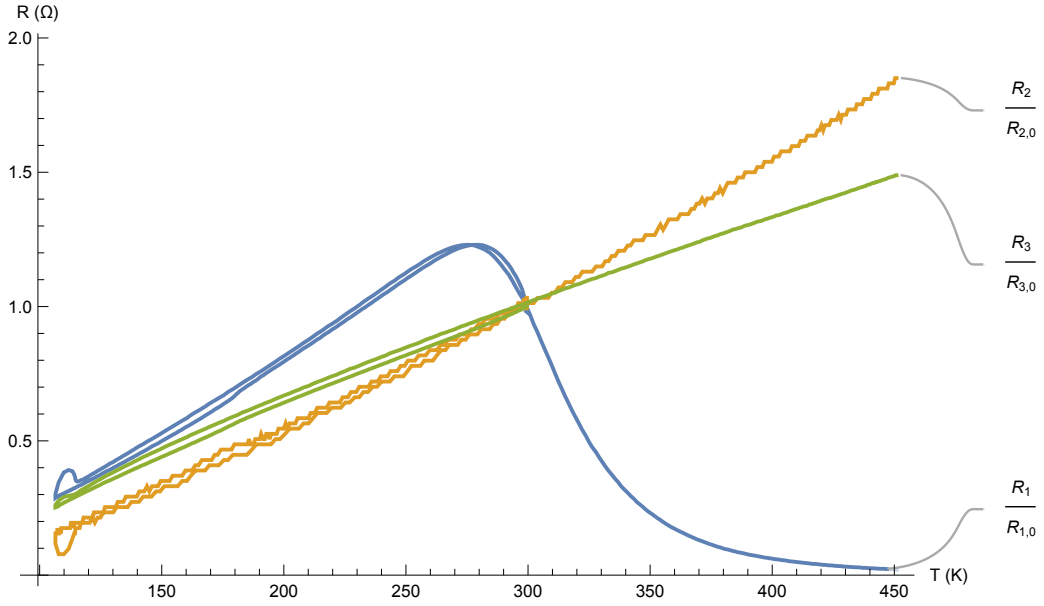
Out[ ]=

t (s)	V_1 (V)	V_2 (V)	V_3 (V)	V_4 (V)	R_1 (Ω)	R_2 (Ω)
0	1.32112	0.0634921	2.33578	2.99267	132.112	6.34921
10	1.3199	0.0634921	2.33578	2.9939	131.99	6.34921
20	1.3199	0.0622711	2.33578	2.9939	131.99	6.22711
30	1.31868	0.0622711	2.337	2.9939	131.868	6.22711
40	1.31868	0.0622711	2.337	2.9939	131.868	6.22711
50	1.31746	0.0622711	2.337	2.99512	131.746	6.22711
60	1.3199	0.0622711	2.337	2.99512	131.99	6.22711
70	1.33211	0.0647131	2.33455	2.99512	133.211	6.47131
80	1.34921	0.0647131	2.33211	2.9939	134.921	6.47131
90	1.36874	0.0634921	2.32723	2.99145	136.874	6.34921
100	1.3895	0.0634921	2.32112	2.98535	138.95	6.34921
110	1.41026	0.0634921	2.31502	2.98046	141.026	6.34921
120	1.43101	0.0634921	2.30769	2.97558	143.101	6.34921
130	1.45177	0.0634921	2.30037	2.96825	145.177	6.34921
140	1.47375	0.0634921	2.29182	2.95971	147.375	6.34921
150	1.49451	0.0622711	2.28327	2.95116	149.451	6.22711
160	1.51526	0.0622711	2.2735	2.94017	151.526	6.22711
170	1.53602	0.0622711	2.26374	2.9304	153.602	6.22711
180	1.55556	0.0610501	2.25275	2.91941	155.556	6.10501
190	1.57387	0.0610501	2.24298	2.90598	157.387	6.10501

rows 1–20 of **559** columns 1–10 of **12**

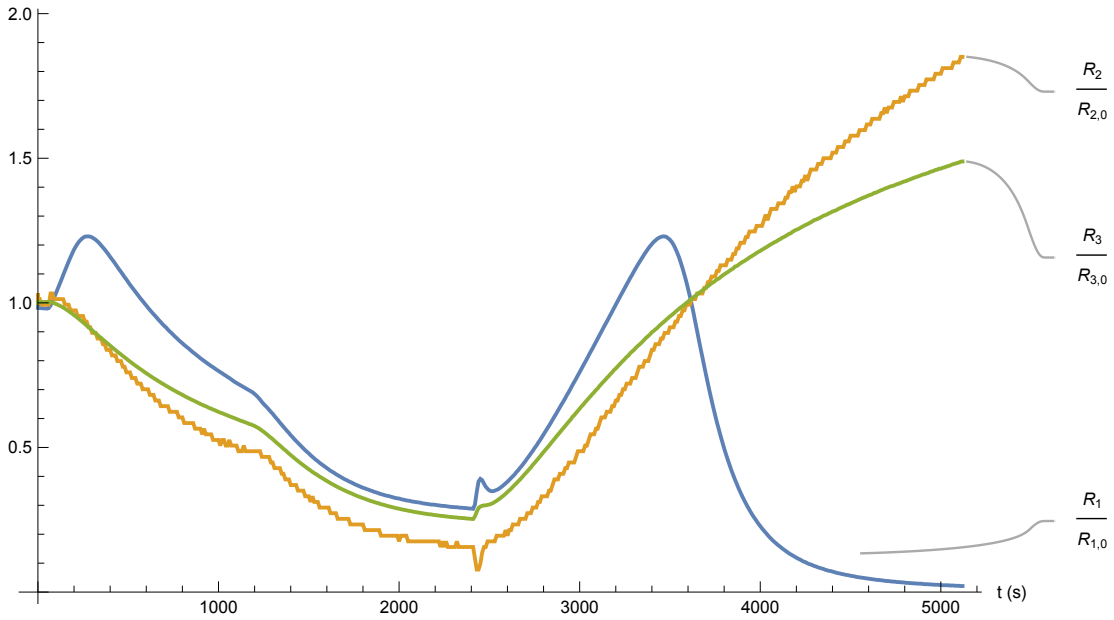
In[ ]:=
```
With[{retr = {"R1/R1,0", "R2/R2,0", "R3/R3,0"}},
 ListLinePlot[Transpose[{data[All, "T (K)"], data[All, #]} // Normal] & /@ retr,
  PlotRange → All, PlotLabels → retr, AxesLabel → {"T (K)", "R (Ω)"}]]
```

Out[ ]=



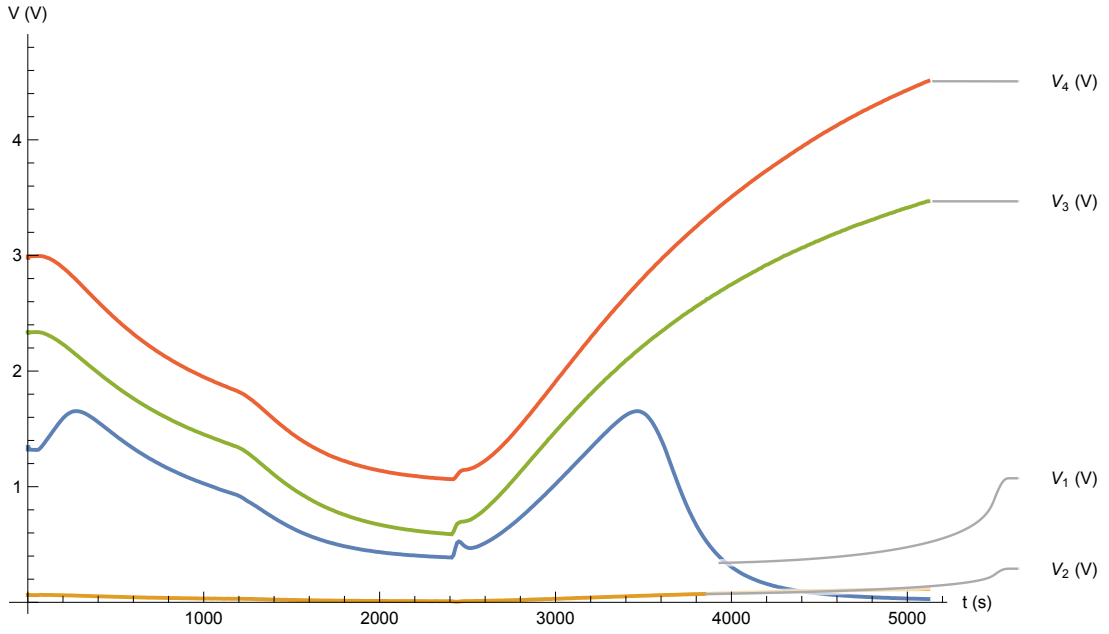
In[ ]:=
```
With[{retr = {"R1/R1,0", "R2/R2,0", "R3/R3,0"}},
 ListLinePlot[Transpose[{data[All, "t (s)"], data[All, #]} // Normal] & /@ retr,
  PlotRange → All, PlotLabels → retr, AxesLabel → {"t (s)"}]]
```

Out[ ]=



In[ ]:=
```
With[{retr = {"V₁ (V)", "V₂ (V)", "V₃ (V)", "V₄ (V)"}},
 ListLinePlot[Transpose[{data[All, "t (s)"], data[All, #]} // Normal] & /@ retr,
  PlotRange → All, PlotLabels → retr, AxesLabel → {"t (s)", "V (V)"}]]
```

Out[ ]=



In[ ]:=
```
z
```

Out[ ]=

z