20231114-Try50X

November 15, 2023

1 Measuring Blood sample on day 13-11-2023

Since the last study showed insignificant when measuring Raman and we suspected that the laser did not reach the blood, we changed the lens magnification from 10X to 50X.

Another configuration that also changed in this measurement is the laser power (10, 0.71A, 358mW), 30 seconds, and no accumulation.

Here we also test the measurement with and without a thin slide attached in front of the 3D-printed tube.

Before the analyse, we performed

```
python3 _preprocess.py -d data/20231114-noslide/ --upper_bound 1570 --lower_bound 0
```

```
python3 _preprocess.py -d data/20231114-slide/ --upper_bound 1570 --lower_bound 0
```

to add meta data and limit the range of spectra

```python
import spectrochempy as scp
from glob import glob
```

2 Let's first see the NO slide configuration

```python
files = sorted(glob(pathname="data/20231114-noslide/*"))
files
```

```
['data/20231114-noslide/indexblood_600_785 nm_30
s_1_2023_11_14_20_28_57_01.txt',
 'data/20231114-noslide/indexnoblood_600_785 nm_30
s_1_2023_11_14_20_30_32_01.txt',
 'data/20231114-noslide/nothing_600_785 nm_30 s_1_2023_11_14_20_25_02_01.txt',
 'data/20231114-noslide/thirdblood_600_785 nm_30
s_1_2023_11_14_20_34_45_01.txt',
 'data/20231114-noslide/thirdnoblood_600_785 nm_30
s_1_2023_11_14_20_37_37_01.txt']
```

```python
all = scp.read_labspec(files)
all.preferences.figure.figsize = (10, 5)
```

```
all
```

[ ]: NDDataset: [float64] unitless (shape: (y:5, x:745))

No such comm: 13912fddf54346c38297ab72e52c311c
No such comm: 13912fddf54346c38297ab72e52c311c
No such comm: 13912fddf54346c38297ab72e52c311c
No such comm: 7f36a308484b42e5a2ef14628303415a
No such comm: 7f36a308484b42e5a2ef14628303415a
No such comm: 7f36a308484b42e5a2ef14628303415a
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No such comm: 0c9a3ada96c1429a86aa451d52b95244
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No such comm: 024c860a9dfc422387992e1b965c0b02
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No such comm: 727e27756a0246a69a82e18c24a1eeb3
No such comm: 6405029aa28c4e7b9d5b897d764f7364
No such comm: 6405029aa28c4e7b9d5b897d764f7364
No such comm: 6405029aa28c4e7b9d5b897d764f7364
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No such comm: 521def19f8f048f8992a47a99a943b8f
No such comm: 3d9c00035dff446a902617e77a3d7ded
No such comm: 3d9c00035dff446a902617e77a3d7ded
No such comm: 3d9c00035dff446a902617e77a3d7ded
No such comm: ad599cad157042eebc0203827bd9a4dd
No such comm: ad599cad157042eebc0203827bd9a4dd
No such comm: ad599cad157042eebc0203827bd9a4dd
No such comm: 9ed3e44ae50145cbb81936c12ae6c646
No such comm: 9ed3e44ae50145cbb81936c12ae6c646
No such comm: 9ed3e44ae50145cbb81936c12ae6c646
No such comm: e3bfb74757754cd18e9a918bd03b369d
No such comm: e3bfb74757754cd18e9a918bd03b369d
No such comm: e3bfb74757754cd18e9a918bd03b369d
No such comm: 2278c78e7b2b400fb63c38a48e729370
No such comm: 2278c78e7b2b400fb63c38a48e729370
No such comm: 2278c78e7b2b400fb63c38a48e729370
No such comm: ac3dbad7dfb7409483742f152b9c1871
No such comm: ac3dbad7dfb7409483742f152b9c1871

```
No such comm: ac3dbad7dfb7409483742f152b9c1871
No such comm: 8a606f5d48cd4f078d2128425f1760a3
No such comm: 8a606f5d48cd4f078d2128425f1760a3
No such comm: 8a606f5d48cd4f078d2128425f1760a3
No such comm: 9d7834588519459997c6740cd9484f24
No such comm: 9d7834588519459997c6740cd9484f24
No such comm: 9d7834588519459997c6740cd9484f24
```

```python
[ ]: index = all[0:2, 0:500]
     nothing = all[2, 0:500]
     third = all[3:5, 0:500]
```

3 Let's check the noise

```python
[ ]: ax = nothing.plot()
     ax.set_title(f"Plot of the noise before the measurement.")
     ax.grid()
```


Plot of the noise before the measurement.
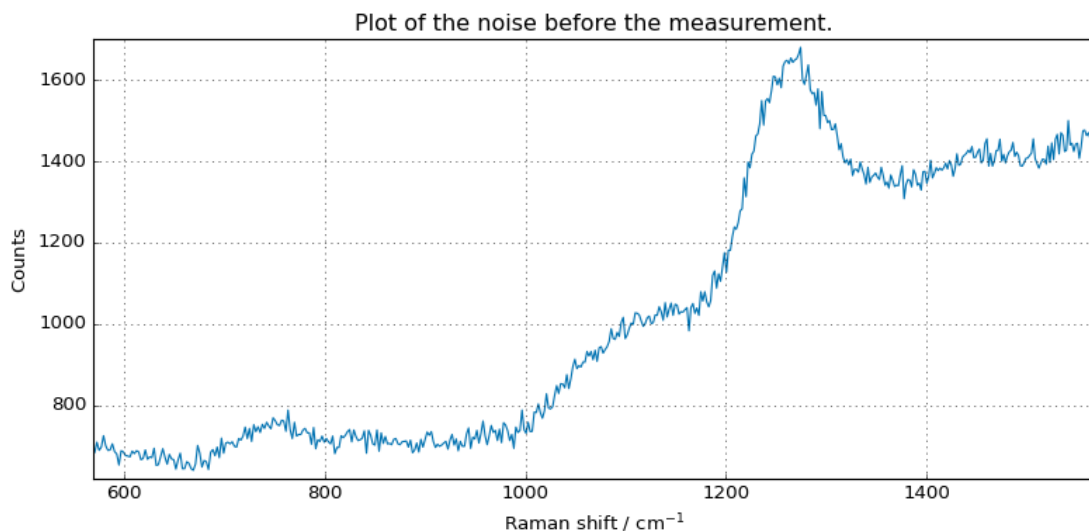
```python
[ ]: ax = scp.plot_multiple(method="pen", datasets=[index[0], index[1]],␣
     ↪labels=['index-nonstretch', 'index-stretch'], legend='best')
     ax.set_title(f"Plot of the index finger.")
     ax.grid()
```

Plot of the index finger.
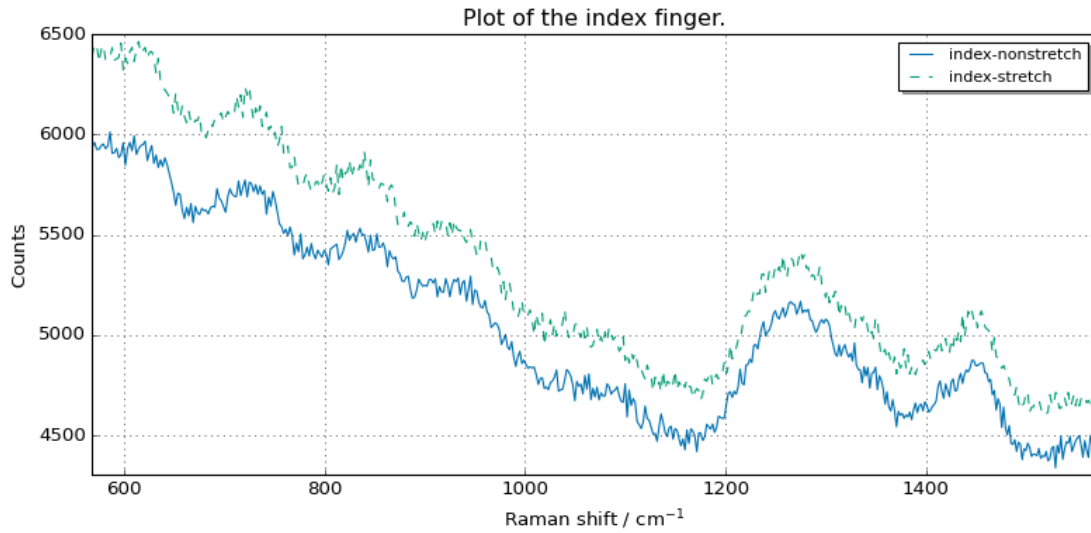
```
ax = scp.plot_multiple(method="pen", datasets=[third[0], third[1]],␣
  ↪labels=['third-nonstretch', 'third-stretch'], legend='best')
ax.set_title(f"Plot of third finger.")
ax.grid()
```


Plot of third finger.
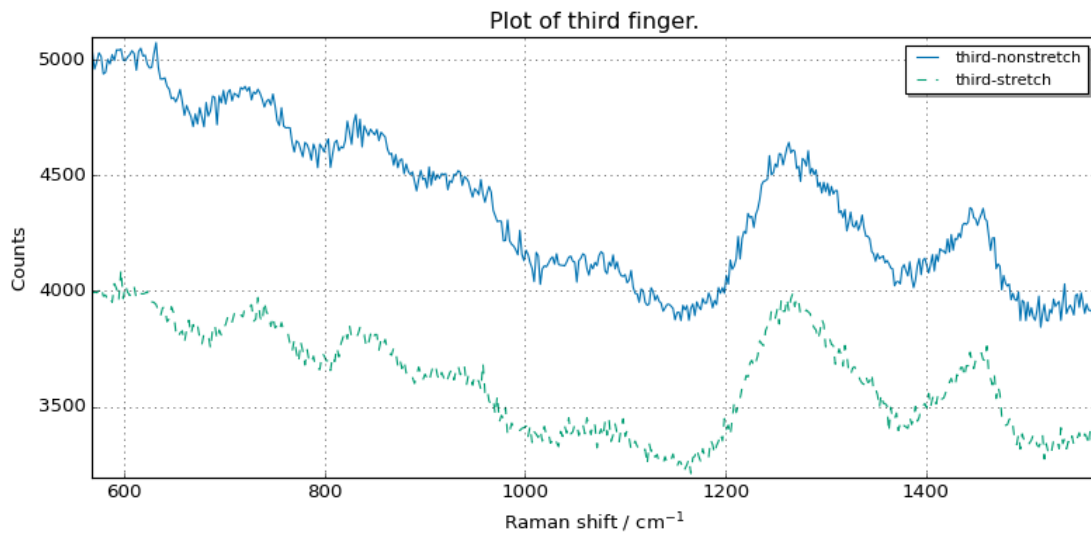
Here, we can see both pairs of measurement do not show significantly different but let preprocess the data anyway.
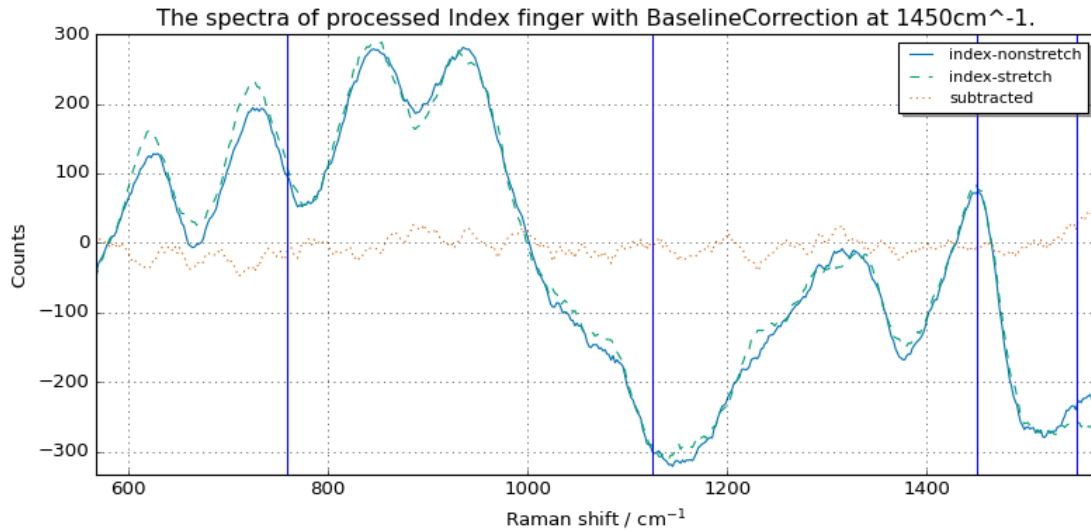
4 Preprocessing

```
[ ]: data = (index.smooth(15) - nothing.smooth(15)).detrend(order=2)
     index_subtract = data[0] - data[1]
     ax = scp.plot_multiple(method="pen", datasets=[data[0], data[1],␣
      ↪index_subtract], labels=['index-nonstretch', 'index-stretch', 'subtracted'],␣
      ↪legend='best')
     ax.vlines(x=1125, ymin=-500, ymax=10000)
     ax.vlines(x=759, ymin=-500, ymax=10000)
     ax.vlines(x=1450, ymin=-500, ymax=10000)
     ax.vlines(x=1550, ymin=-500, ymax=10000)
     ax.set_title(f'The spectra of processed Index finger without BaselineCorrection.
      ↪')
     ax.grid()
```
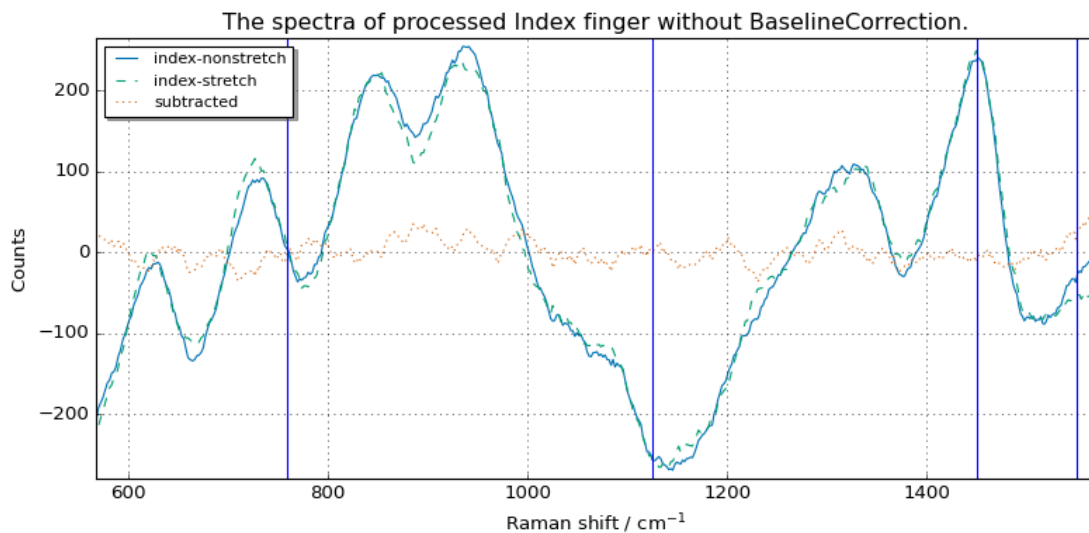

The spectra of processed Index finger without BaselineCorrection.

```
[ ]: # Baseline at 1450
     blc = scp.Baseline(ranges=(1430,1470))
     blc.fit((index.smooth(15) - nothing.smooth(15)).detrend(order=2))
     data = blc.transform()
     index_subtract = data[0] - data[1]
     ax = scp.plot_multiple(method="pen", datasets=[data[0], data[1],␣
      ↪index_subtract], labels=['index-nonstretch', 'index-stretch', 'subtracted'],␣
      ↪legend='best')
     ax.vlines(x=1125, ymin=-500, ymax=10000)
     ax.vlines(x=759, ymin=-500, ymax=10000)
     ax.vlines(x=1450, ymin=-500, ymax=10000)
     ax.vlines(x=1550, ymin=-500, ymax=10000)
```

```
ax.set_title(f'The spectra of processed Index finger with BaselineCorrection at␣
  ↪1450cm^-1.')
ax.grid()
```

The spectra of processed Index finger with BaselineCorrection at 1450cm^-1.

4.1 Third finger

```
# Baseline at 1450
blc = scp.Baseline(ranges=(1430,1470))
blc.fit((third.smooth(15) - nothing.smooth(15)).detrend(order=2))
data = blc.transform()
third_subtract = data[0] - data[1]
ax = scp.plot_multiple(method="pen", datasets=[data[0], data[1],␣
  ↪third_subtract], labels=['third-nonstretch', 'third-stretch', 'subtracted'],␣
  ↪legend='best')
ax.vlines(x=1125, ymin=-500, ymax=10000)
ax.vlines(x=759, ymin=-500, ymax=10000)
ax.vlines(x=1450, ymin=-500, ymax=10000)
ax.vlines(x=1550, ymin=-500, ymax=10000)
ax.set_title(f'The spectra of processed third finger with BaselineCorrection at␣
  ↪1450cm^-1.')
ax.grid()
```

The spectra of processed third finger with BaselineCorrection at 1450cm^-1.
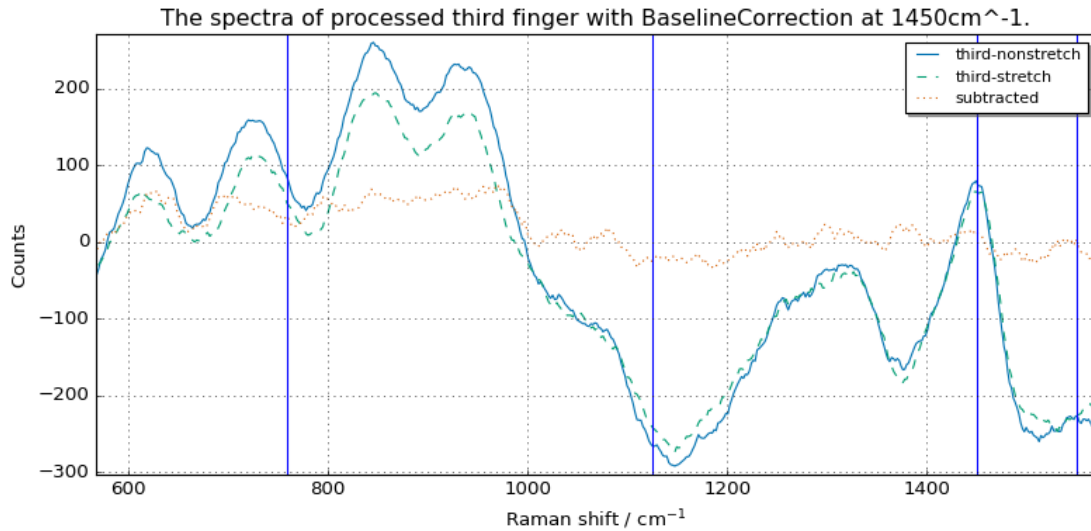
5 Measurement with slide attached

```
files = sorted(glob(pathname="data/20231114-slide/*"))
files
```

```
['data/20231114-slide/indexblood_600_785 nm_30 s_1_2023_11_14_20_47_43_01.txt',
 'data/20231114-slide/indexnoblood_600_785 nm_30
s_1_2023_11_14_20_48_28_01.txt',
 'data/20231114-slide/middleblood_600_785 nm_30 s_1_2023_11_14_20_54_00_01.txt',
 'data/20231114-slide/middlenoblood_600_785 nm_30
s_1_2023_11_14_20_54_46_01.txt',
 'data/20231114-slide/nailfold_600_785 nm_30 s_1_2023_11_14_20_56_37_01.txt',
 'data/20231114-slide/noise_600_785 nm_30 s_1_2023_11_14_20_43_14_01.txt',
 'data/20231114-slide/nothing_600_785 nm_30 s_1_2023_11_14_20_45_28_01.txt',
 'data/20231114-slide/thenar_600_785 nm_30 s_1_2023_11_14_20_58_41_01.txt',
 'data/20231114-slide/thirdblood_600_785 nm_30 s_1_2023_11_14_20_51_59_01.txt',
 'data/20231114-slide/thirdnoblood_600_785 nm_30
s_1_2023_11_14_20_52_43_01.txt']
```

```
all = scp.read_labspec(files)
all.preferences.figure.figsize = (10, 5)
all
```

NDDataset: [float64] unitless (shape: (y:10, x:745))

```
No such comm: 89a9e83659ff4f988825358d8d130817
No such comm: 89a9e83659ff4f988825358d8d130817
No such comm: 89a9e83659ff4f988825358d8d130817
No such comm: 7fb423e4978442788f2a87972c0cfd49
```
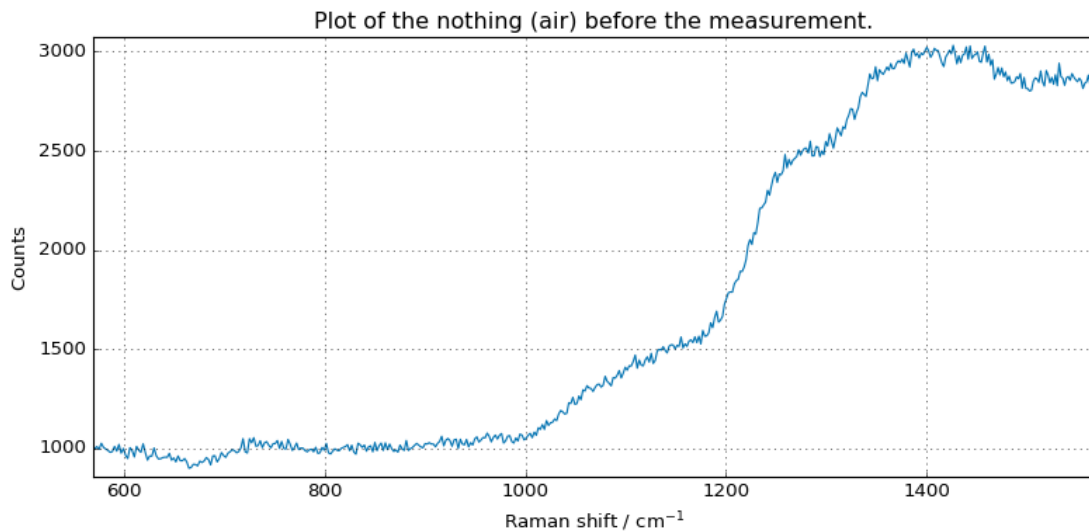
7

```
No such comm: 7fb423e4978442788f2a87972c0cfd49
No such comm: 7fb423e4978442788f2a87972c0cfd49
No such comm: 87dec7dec67245fc87bf4f4573fac291
No such comm: 87dec7dec67245fc87bf4f4573fac291
No such comm: 87dec7dec67245fc87bf4f4573fac291
No such comm: 0ba18ccfa0eb4f2baf43d5416e72afe5
No such comm: 0ba18ccfa0eb4f2baf43d5416e72afe5
No such comm: 0ba18ccfa0eb4f2baf43d5416e72afe5
No such comm: dce9af066f134b9ba1c4341053516f21
No such comm: dce9af066f134b9ba1c4341053516f21
No such comm: dce9af066f134b9ba1c4341053516f21
No such comm: 2585eb7cea17494793d39adf1db33b2c
No such comm: 2585eb7cea17494793d39adf1db33b2c
No such comm: 2585eb7cea17494793d39adf1db33b2c
No such comm: 057e717e99ba4817aa154c95291b0f58
No such comm: 057e717e99ba4817aa154c95291b0f58
No such comm: 057e717e99ba4817aa154c95291b0f58
No such comm: 9c2de30b63964fc8a7fdba87f0281376
No such comm: 9c2de30b63964fc8a7fdba87f0281376
No such comm: 9c2de30b63964fc8a7fdba87f0281376
No such comm: 898fcaae5afc4905a1c91b84b223937a
No such comm: 898fcaae5afc4905a1c91b84b223937a
No such comm: 898fcaae5afc4905a1c91b84b223937a
No such comm: 8aef0b793f414fd2baea3b2f567f3c57
No such comm: 8aef0b793f414fd2baea3b2f567f3c57
No such comm: 8aef0b793f414fd2baea3b2f567f3c57
No such comm: d8be833476e7494c80e9d4075af7d7f7
No such comm: d8be833476e7494c80e9d4075af7d7f7
No such comm: d8be833476e7494c80e9d4075af7d7f7
No such comm: aba3270d82594bf785ee72411a5a8237
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No such comm: aba3270d82594bf785ee72411a5a8237
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No such comm: b2afaffe5ade42c9b5d4666ba738dd59
No such comm: b2afaffe5ade42c9b5d4666ba738dd59
No such comm: 4d688726f68c459fa1600c9df9ec5be5
No such comm: 4d688726f68c459fa1600c9df9ec5be5
No such comm: 4d688726f68c459fa1600c9df9ec5be5
```
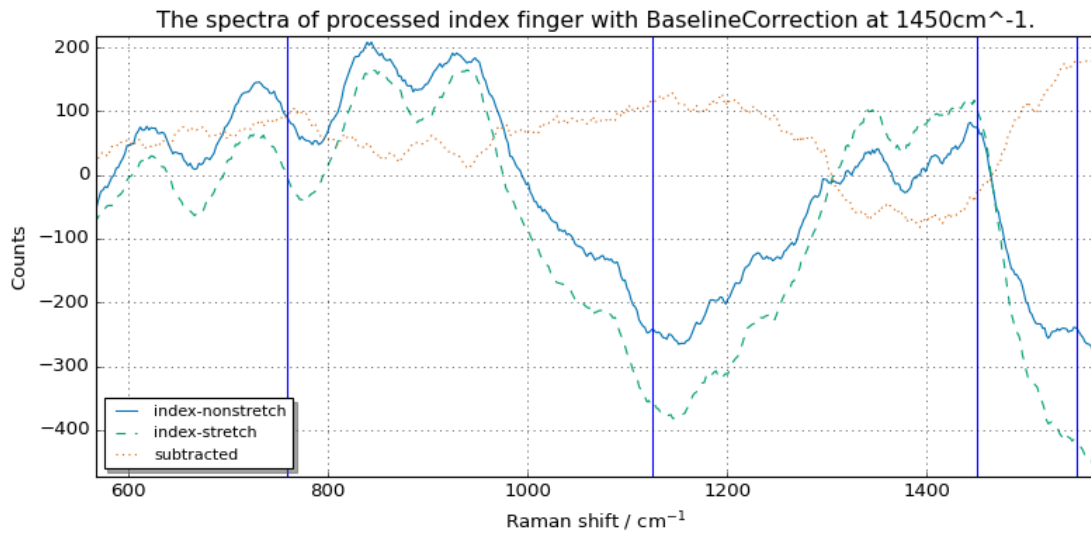
```python
index = all[0:2, 0:500]
middle = all[2:4, 0:500]
nailfold = all[4, 0:500]
nothing = all[6, 0:500]
thenar = all[7, 0:500]
third = all[8:10, 0:500]
```
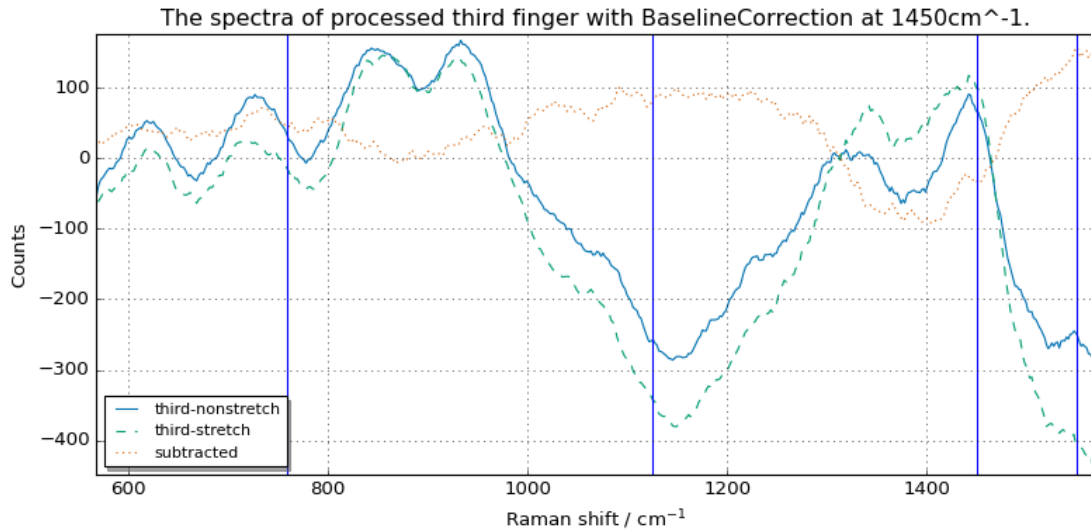
```
ax = nothing.plot()
ax.set_title(f"Plot of the nothing (air) before the measurement.")
ax.grid()
```

Plot of the nothing (air) before the measurement.


```
# Baseline at 1450
blc = scp.Baseline(ranges=(1430,1470))
blc.fit((index.smooth(15) - nothing.smooth(15)).detrend(order=2))
data = blc.transform()
index_subtract = data[0] - data[1]
ax = scp.plot_multiple(method="pen", datasets=[data[0], data[1],␣
 ↪index_subtract], labels=['index-nonstretch', 'index-stretch', 'subtracted'],␣
 ↪legend='best')
ax.vlines(x=1125, ymin=-500, ymax=10000)
ax.vlines(x=759, ymin=-500, ymax=10000)
ax.vlines(x=1450, ymin=-500, ymax=10000)
ax.vlines(x=1550, ymin=-500, ymax=10000)
ax.set_title(f'The spectra of processed index finger with BaselineCorrection at␣
 ↪1450cm^-1.')
ax.grid()
```

The spectra of processed index finger with BaselineCorrection at 1450cm^-1.

```
# Baseline at 1450
blc = scp.Baseline(ranges=(1430,1470))
blc.fit((third.smooth(15) - nothing.smooth(15)).detrend(order=2))
data = blc.transform()
third_subtract = data[0] - data[1]
ax = scp.plot_multiple(method="pen", datasets=[data[0], data[1],␣
 ↪third_subtract], labels=['third-nonstretch', 'third-stretch', 'subtracted'],␣
 ↪legend='best')
ax.vlines(x=1125, ymin=-500, ymax=10000)
ax.vlines(x=759, ymin=-500, ymax=10000)
ax.vlines(x=1450, ymin=-500, ymax=10000)
ax.vlines(x=1550, ymin=-500, ymax=10000)
ax.set_title(f'The spectra of processed third finger with BaselineCorrection at␣
 ↪1450cm^-1.')
ax.grid()
```

The spectra of processed third finger with BaselineCorrection at 1450cm^-1.


```
ax = scp.plot_multiple(method="pen", datasets=[nailfold.smooth(15), nailfold.
  ↪smooth(15) - nothing.smooth(15)], labels=['nailfold', 'nailfold no noise'],
  ↪legend='best')
ax.vlines(x=1125, ymin=-500, ymax=10000)
ax.vlines(x=759, ymin=-500, ymax=10000)
ax.vlines(x=1450, ymin=-500, ymax=10000)
ax.vlines(x=1550, ymin=-500, ymax=10000)
ax.set_title(f'The spectra of processed nailfold')
ax.grid()
```

The spectra of processed nailfold
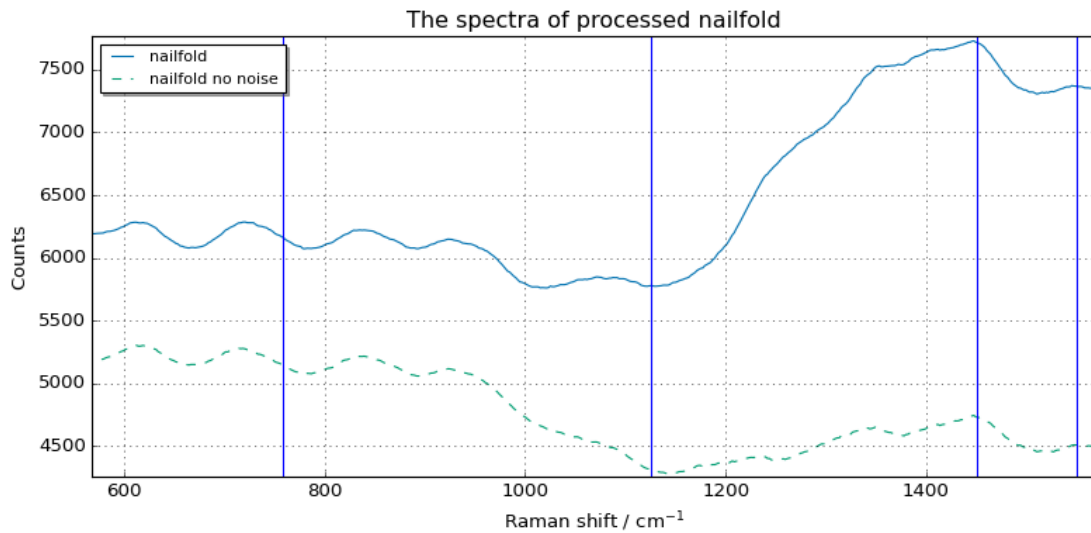
```
[ ]: ax = scp.plot_multiple(method="pen", datasets=[thenar.smooth(15), thenar.
    ↪smooth(15) - nothing.smooth(15)], labels=['thenar', 'thenar no noise'],␣
    ↪legend='best')
ax.vlines(x=1125, ymin=-500, ymax=10000)
ax.vlines(x=759, ymin=-500, ymax=10000)
ax.vlines(x=1450, ymin=-500, ymax=10000)
ax.vlines(x=1550, ymin=-500, ymax=10000)
ax.set_title(f'The spectra of processed thenar')
ax.grid()
```
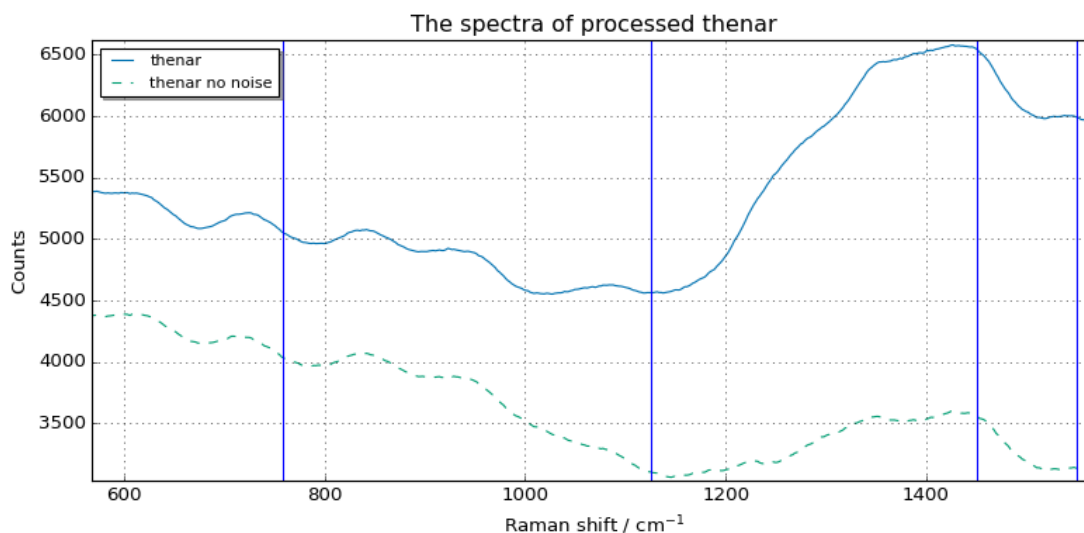

6 Summary

The thin-slide approach clearly fails because it is difficult to control the force when we apply pressure on the slide. Thus, the measurement is way off.

The reason why we did not see the differences in stretch and no-stretch could be that the laser did pick up the blood (as we see wavenumber 1450 cm^-1), and our stretching method did not remove blood from the measuring spot. On the good side, every measurement is now consistent (unlike all the previous sessions the measurements were all over the place).

Maybe, we should try OGTT again.