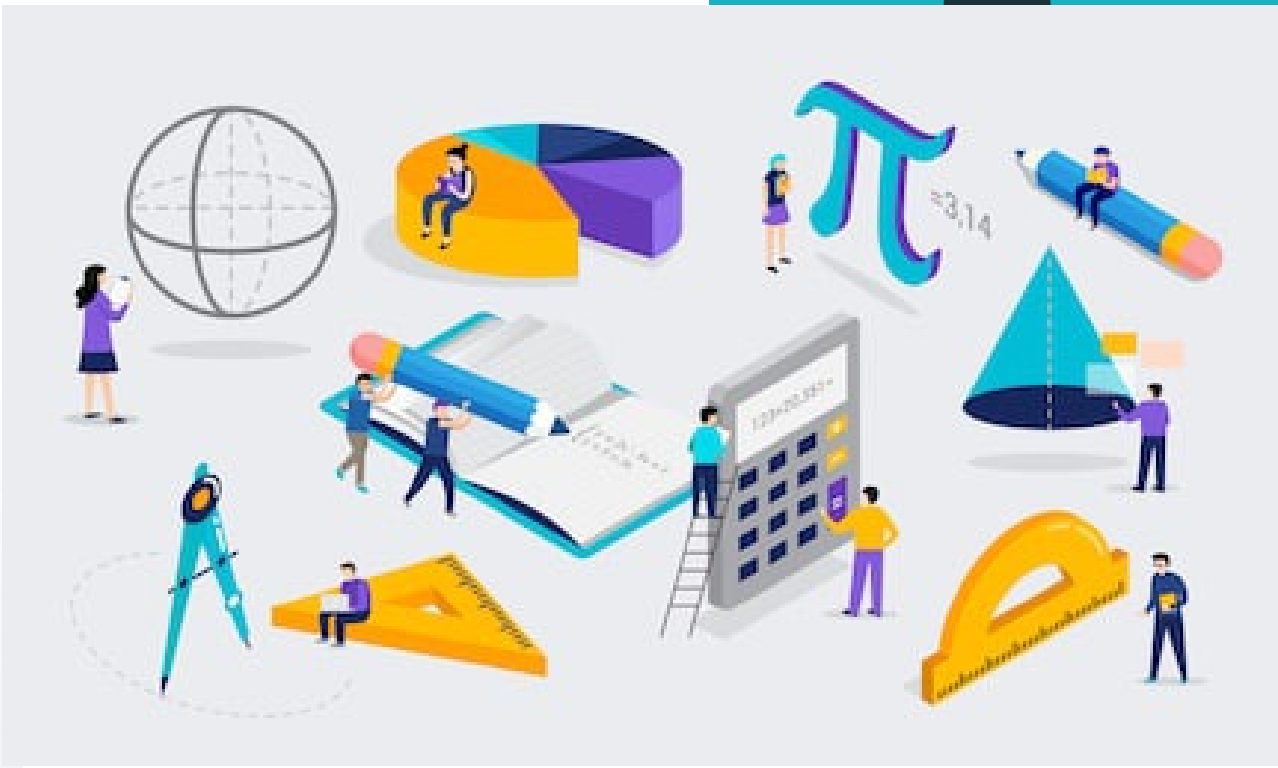
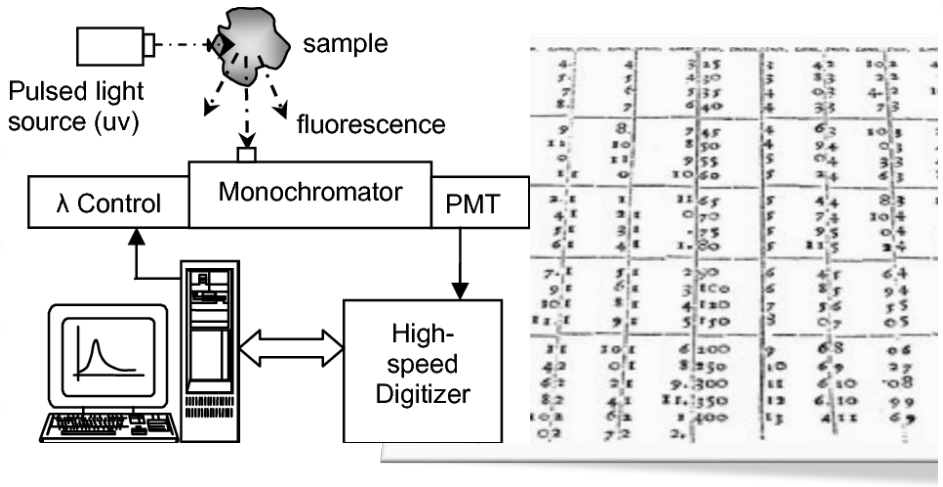
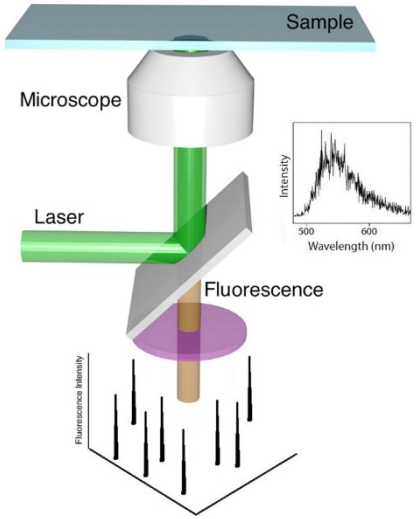
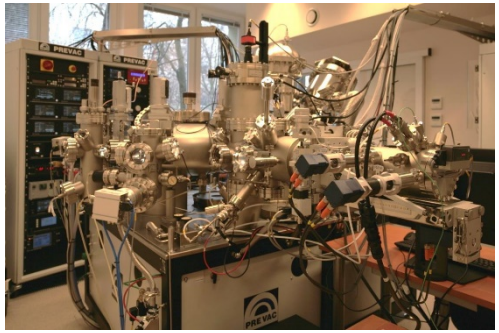
How to Make Your Graphics Stand Out

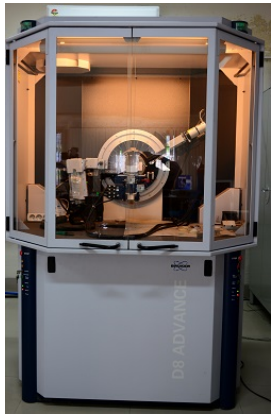


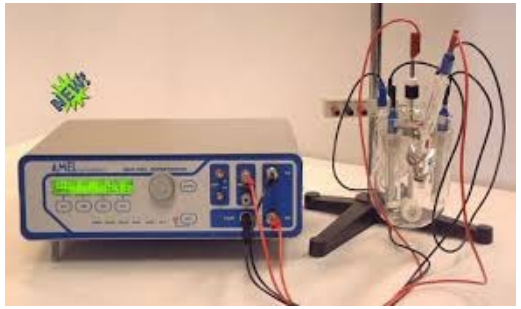
What are different ways we can present data?

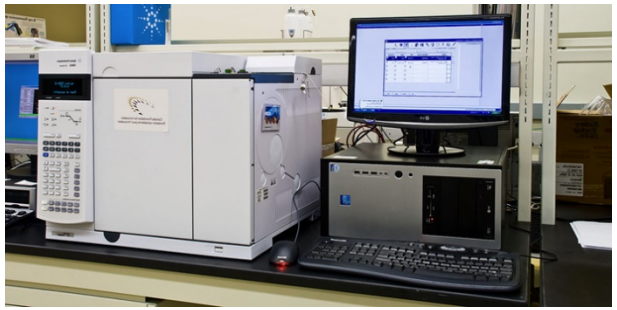




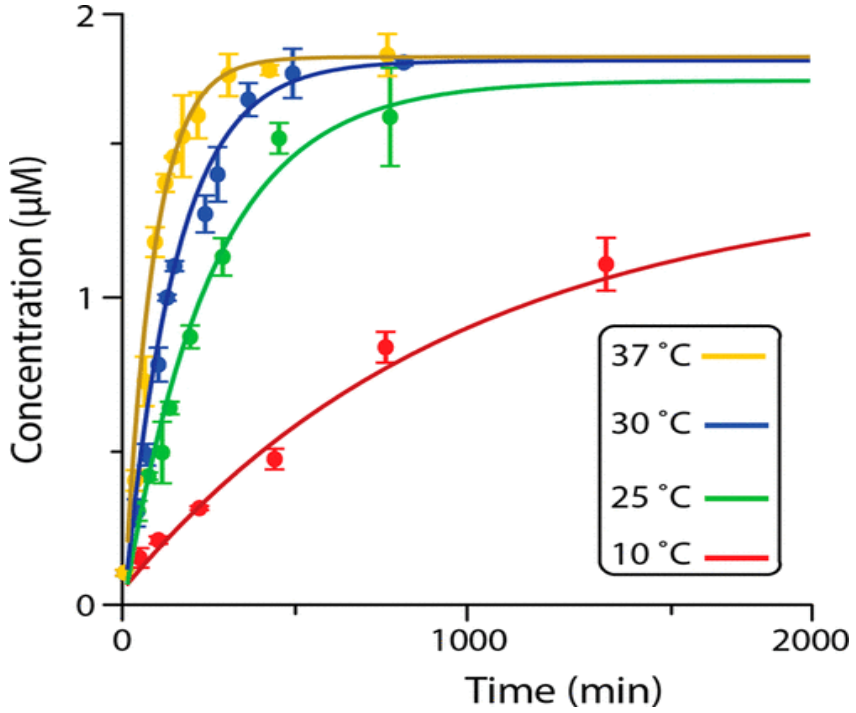






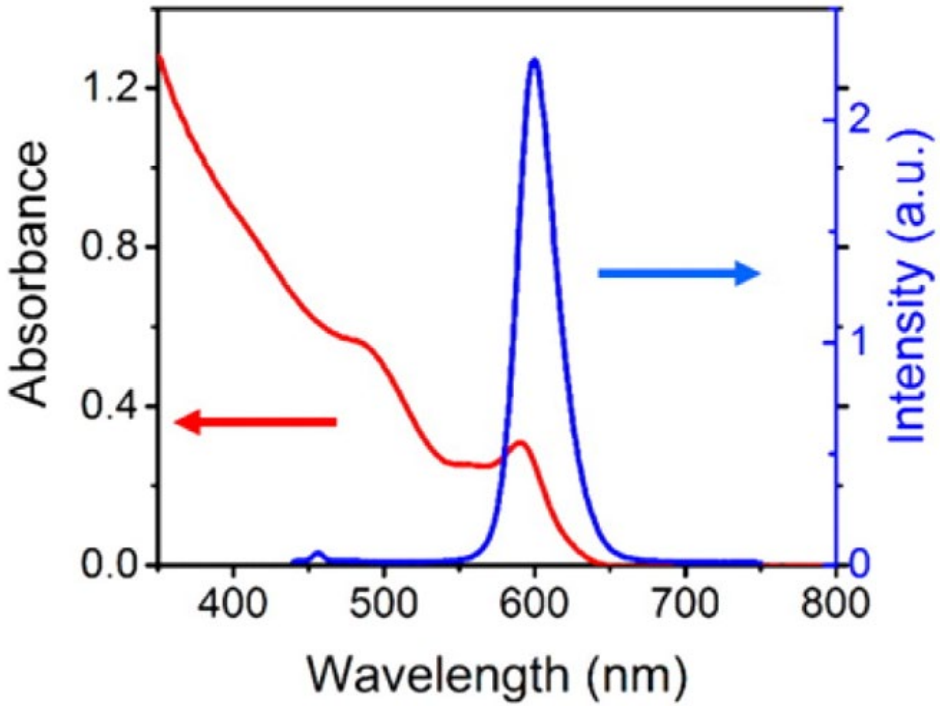


X-Y Plot



- Correct use of data point symbols with error bars
- Kinetic fits color coded to match data point colors

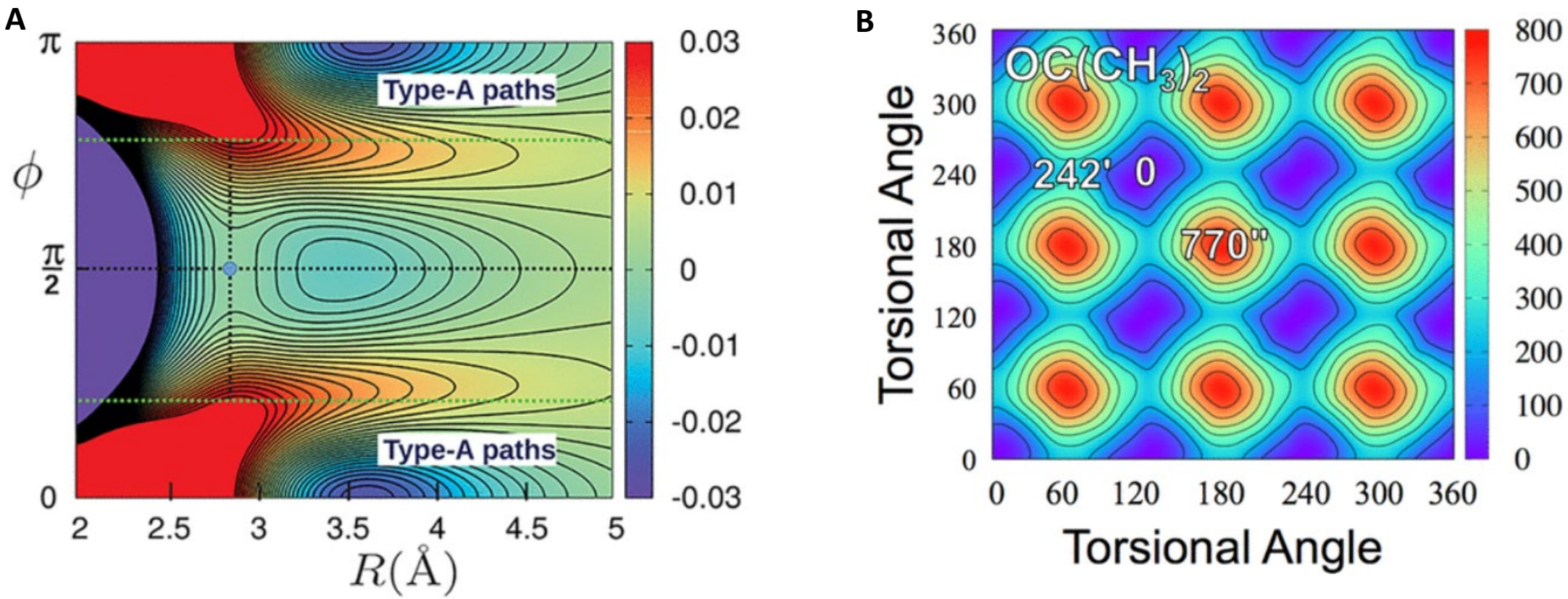
X-Y-Y Plot



- Good use of arrows and color to indicate corresponding y-axes

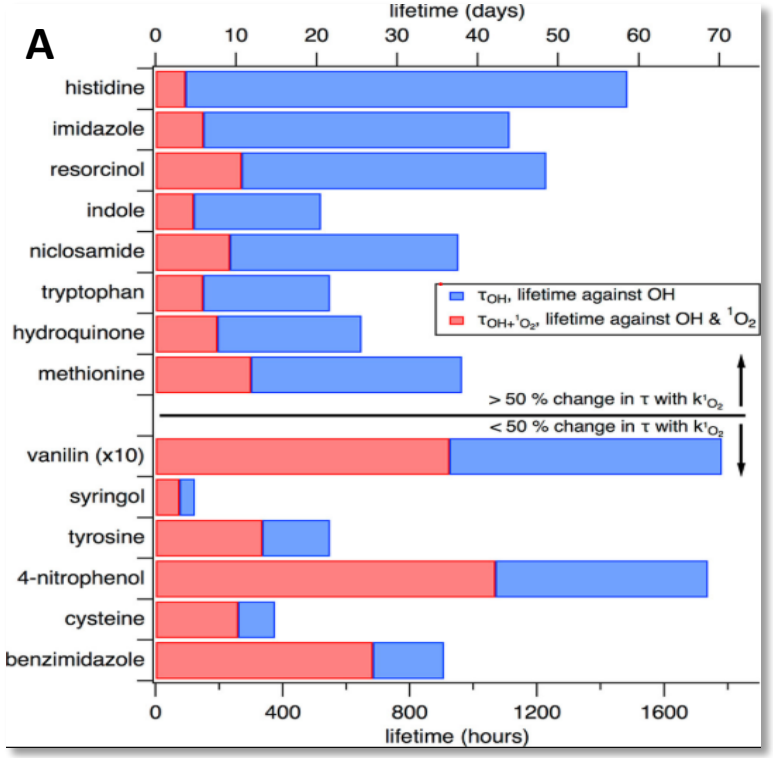
X-Y Plot with error bar and data fit and X-Y-Y plot showing how to identify corresponding y-axes
Sources: Source: **DOI:** 10.1021/acs.biochem.9b00532 **DOI** 10.1021/acs.chemmater.5b01689

2-D Plots

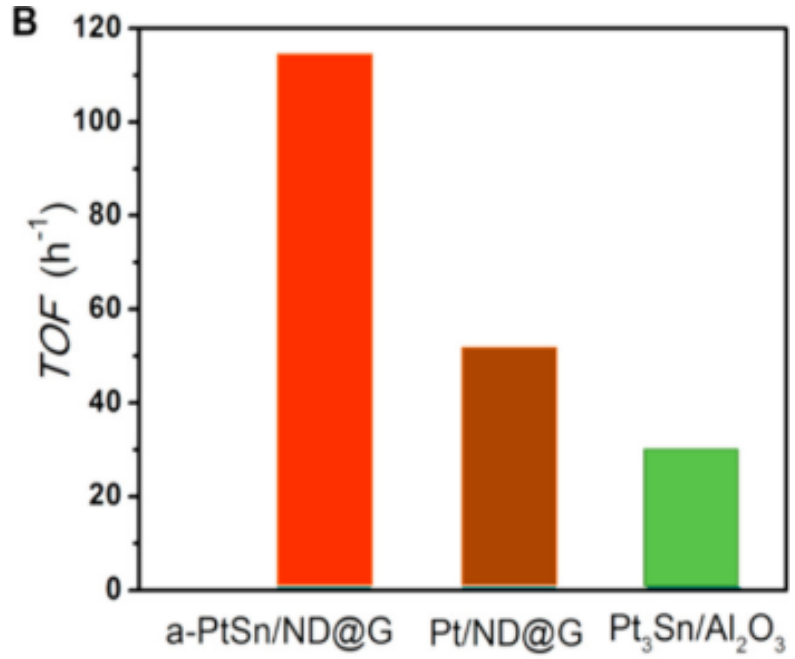


Two examples of high-quality 2-D contour plots
Sources: **DOI** 10.1021/acs.jpca.9b04938, **DOI** 10.1021/acs.jpca.9b03592

Bar and Column Graph



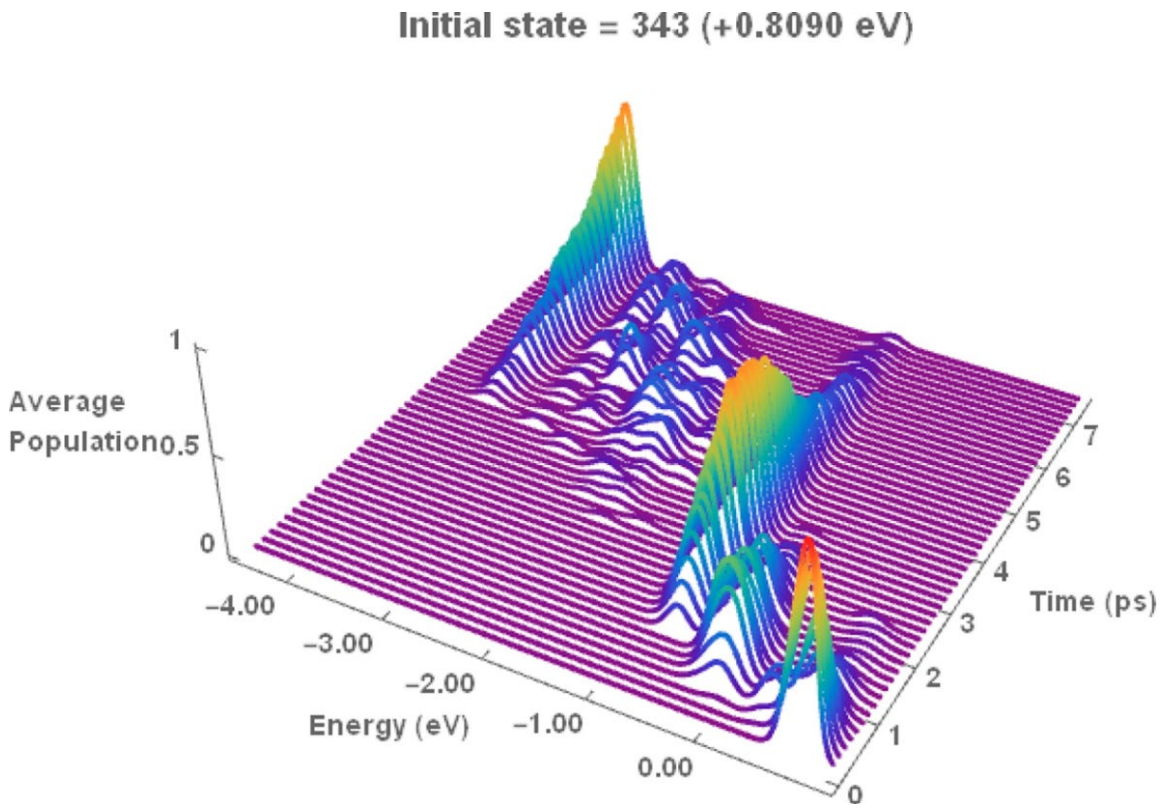
Bar graph
- Clearly labeled
- Easy to compare and contrast samples



Column graph
- Bright and vibrant colors
- Effective presentation of noncausal data
- Correct axis labeling

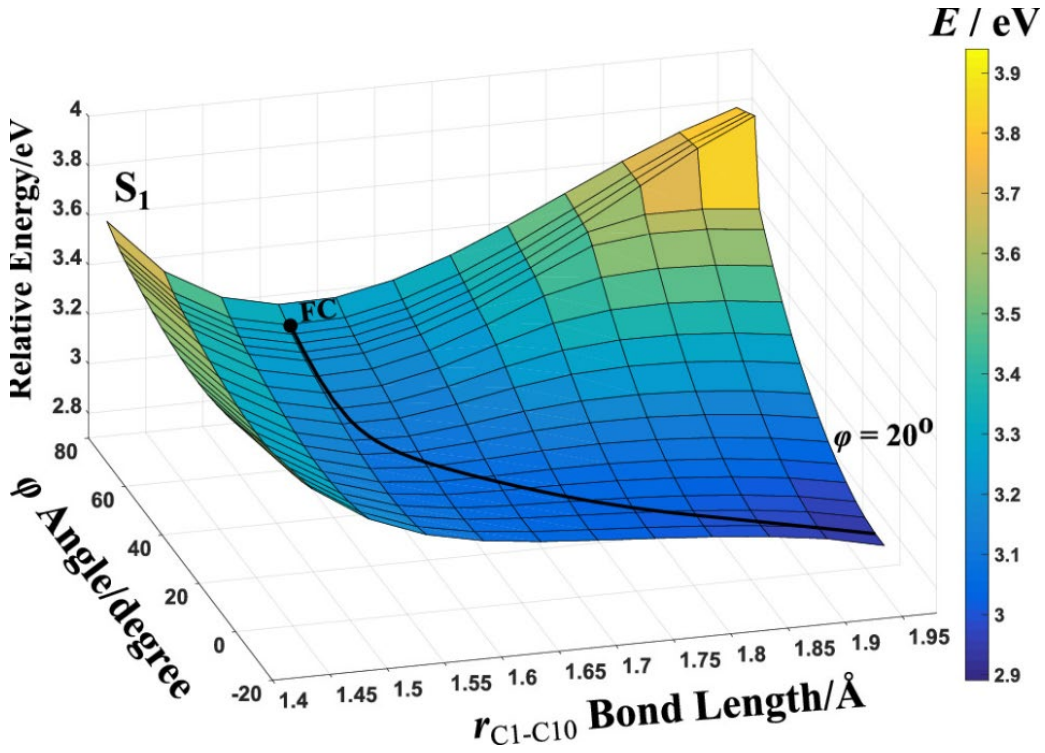
(A) Bar and **(B)** column graphs to present noncausal data
Sources: 10.1021/acs.est.9b01609, 10.1021/acscatal.9b00601

Waterfall Plot



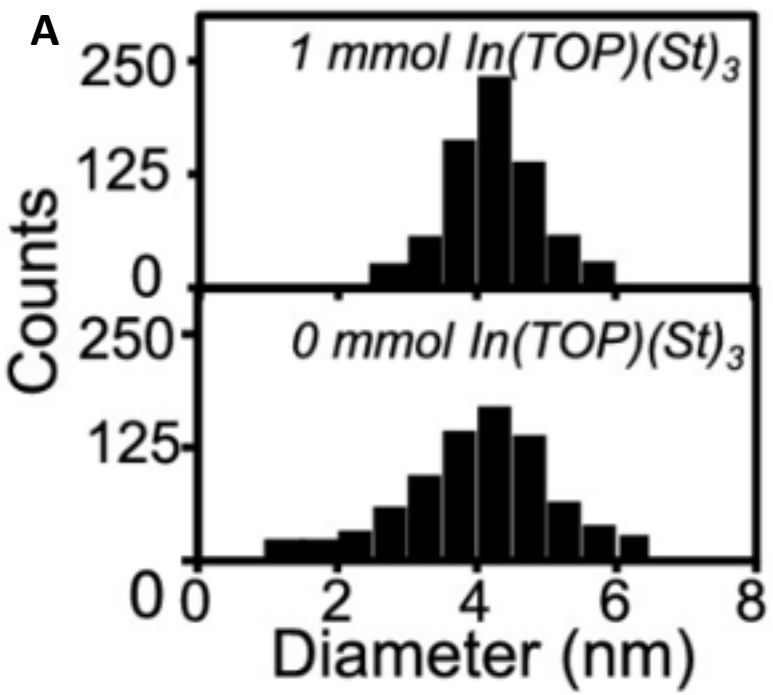
Good use of contrasting colors in a waterfall plot
Source: **DOI** 10.1021/acs.jpclett.6b00283

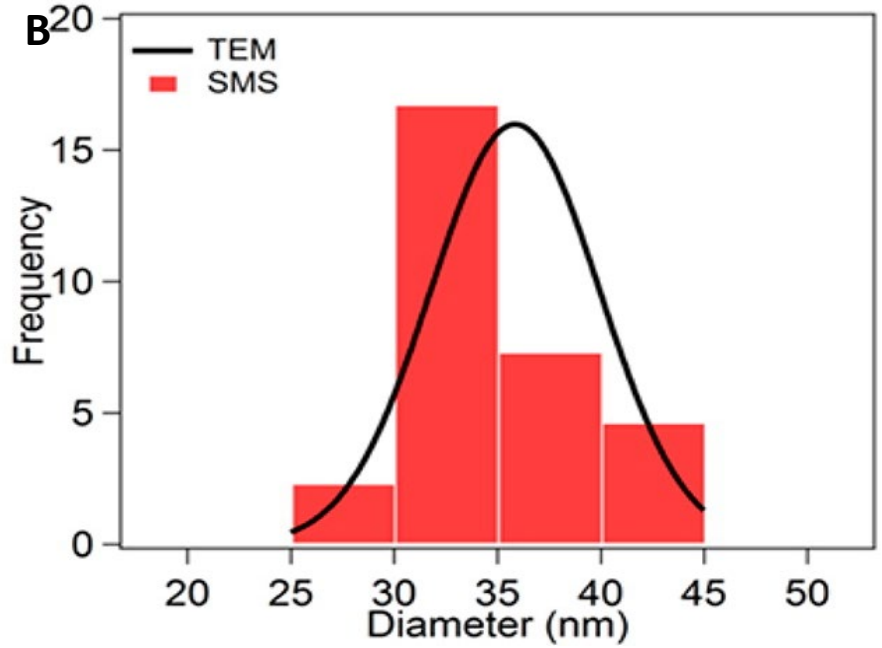
3-D Plot



3D plot (surface plot) showing the functional relationship between one dependent variable and two independent variables.
Source: DOI 10.1021/acs.jpclett.9b01522

Histograms

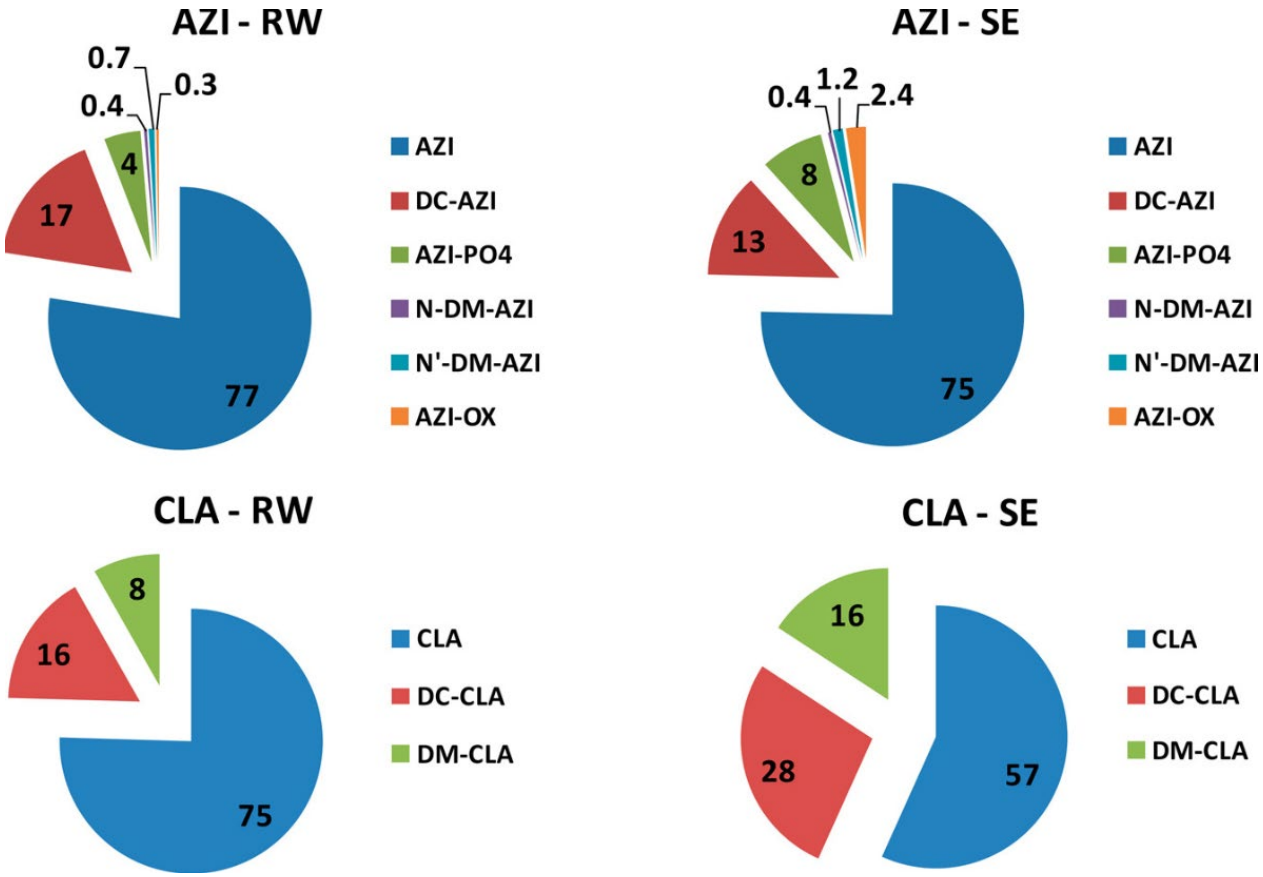




TIP: "It is clear that the appearance of the histogram is fundamentally dependent on the bin width. The bin width must be chosen to be small enough to show the distribution as a discrete function but not too small as to capture only individual points and return the original data set."
DOI: 10.1021/acs.chemmater.6b03430

All text in these histograms are complete and legible without having to enlarge the graphics. Note: The bin width can make the distributions look different
Sources: **DOI** 10.1021/acs.chemmater9b02292, **DOI** 10.1021/jz501409q

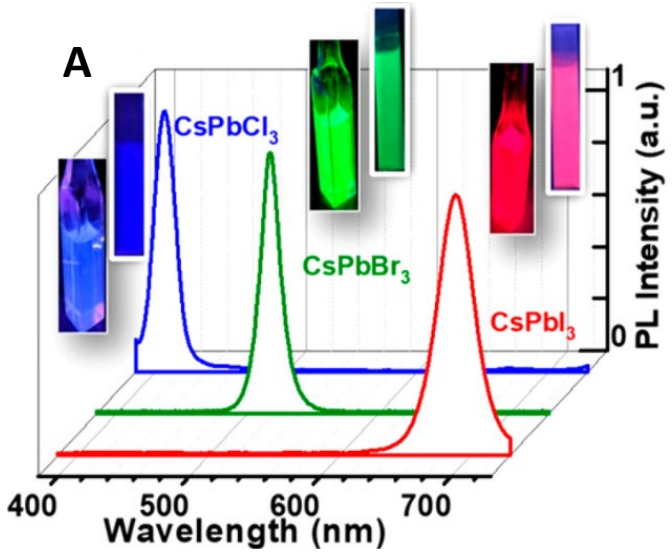
Pie Charts



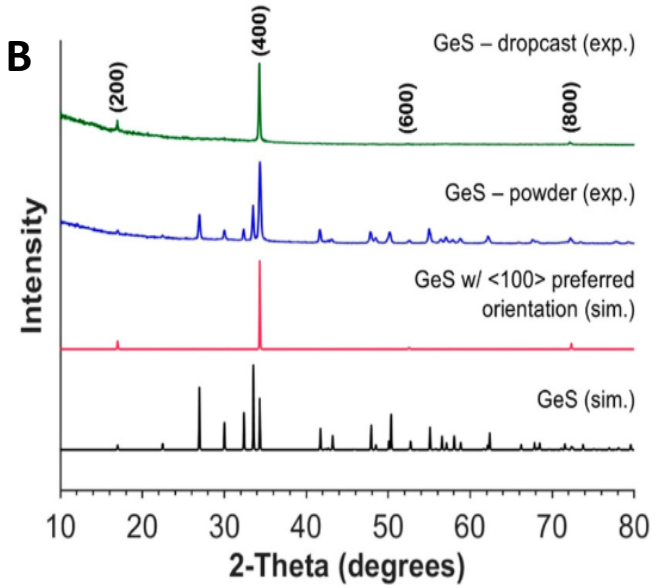
- **Labels are concise, easy to read**
- **Proportions are clearly identified**

Clear presentation of data via pie charts.
Source: DOI 10.1021/acs.est.9b01420

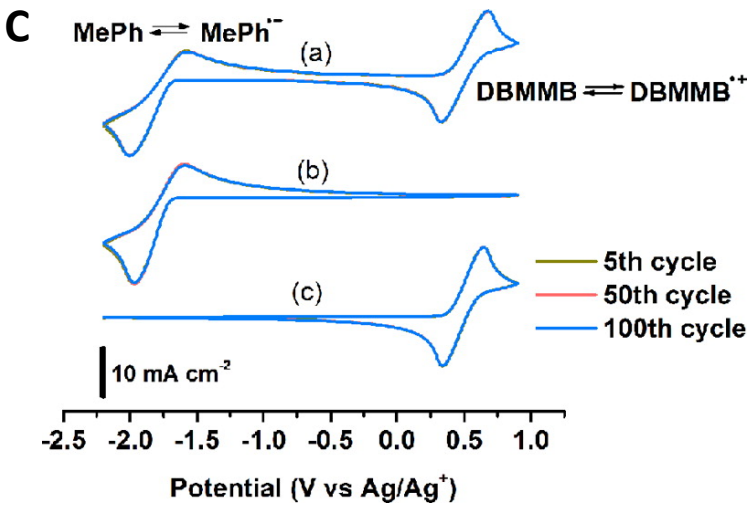
Axis Offset for Multiple Data Set Presentation



- Multiple spectra with shifted X- axis offset
- Provides a good visual distinction among the spectra



- Multiple spectra with y-axis offset
- Allows comparison of peak positions

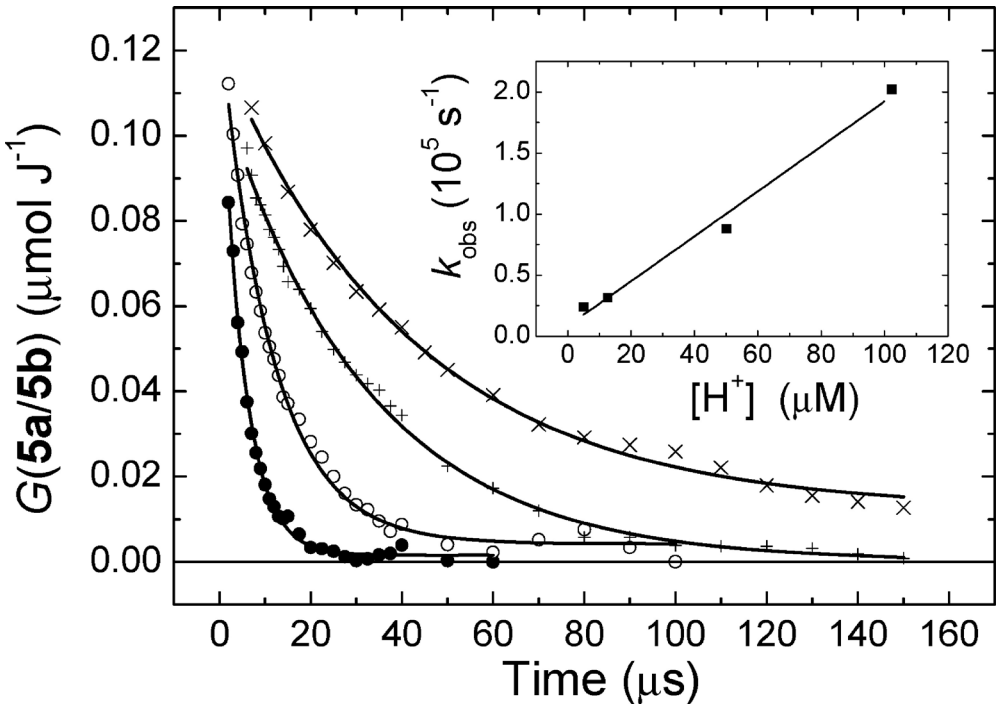


- Multiple offset data with allow comparison of cyclic voltammograms
- Current quantified properly using scale bar

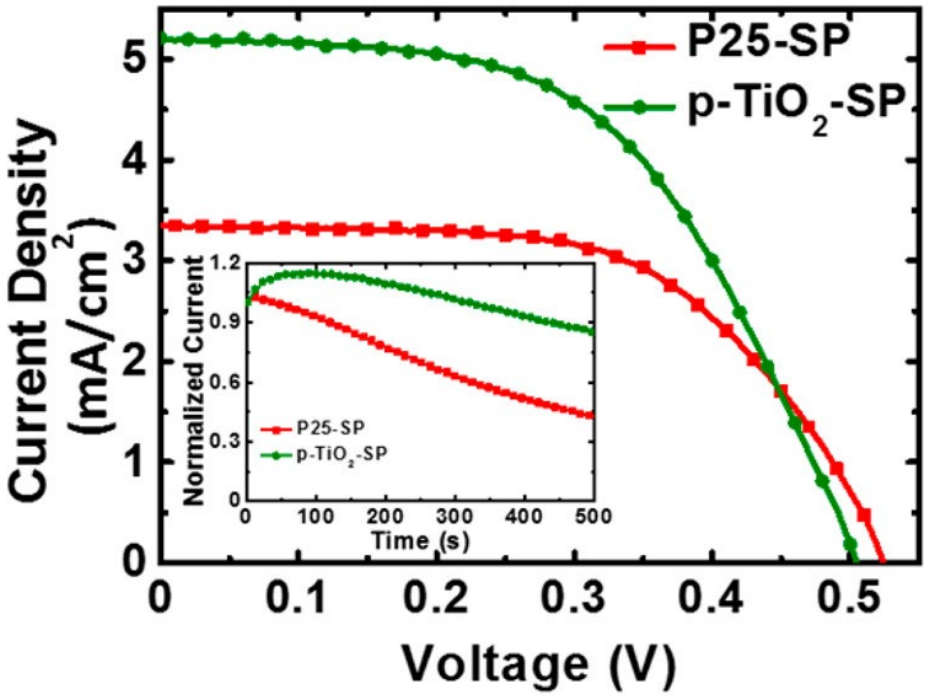
Multiple spectra in a single plot
Sources: **DOI** 10.1021/jacs.8b04803, **DOI** 10.1021/acsnano.9b05157, **DOI** 10.1021/acsenergylett.6b00255

Multiple Data Presentation - Graphs with Insets

A



B



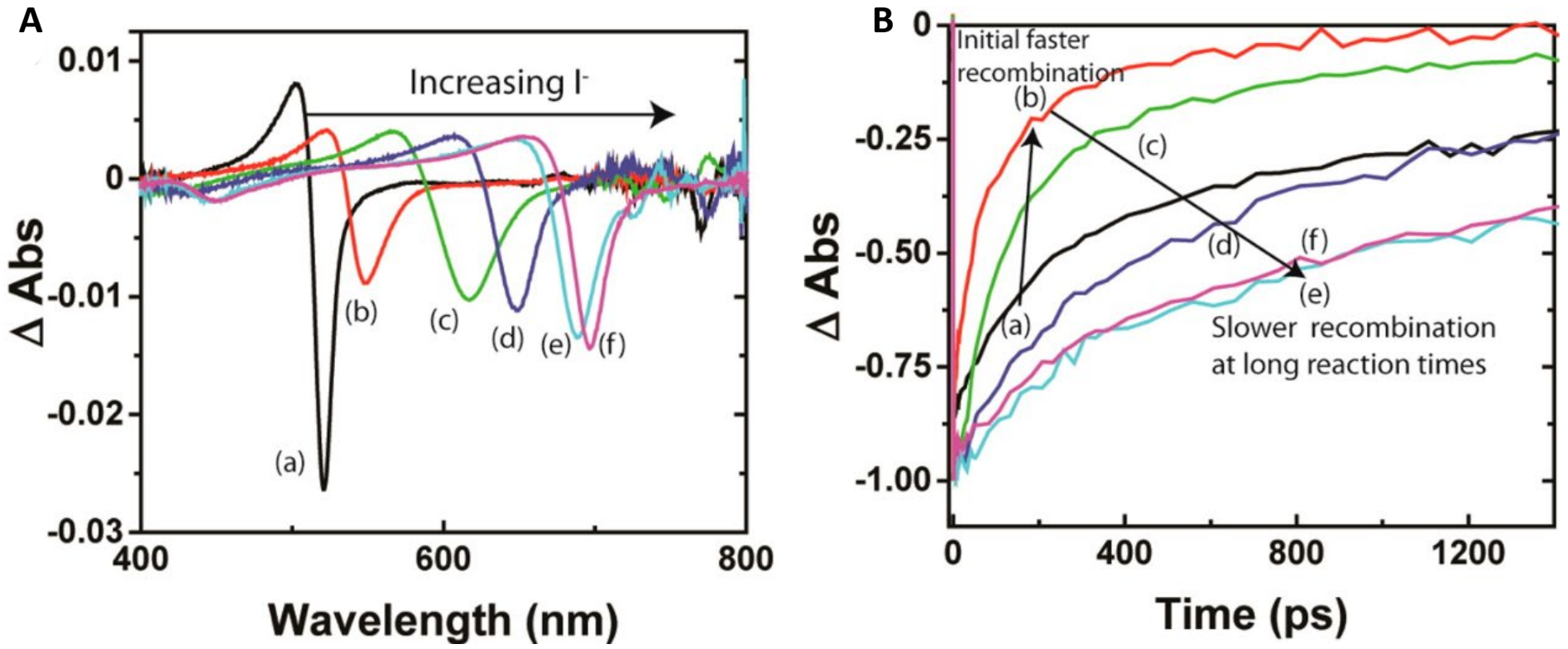
- Inset is used to show the analysis of the main set of traces
- All the text and linewidth in the inset are legible
- Correct representation of units in the main figure and inset

- Distinguishable colors with clearly identified legends in both the main figure and inset
- The inset shows a related property of the main set of data

Good presentation of insets

Sources: **DOI** 10.1021/jp071191w, **DOI** 10.1021/acs.jpcc.7b05207

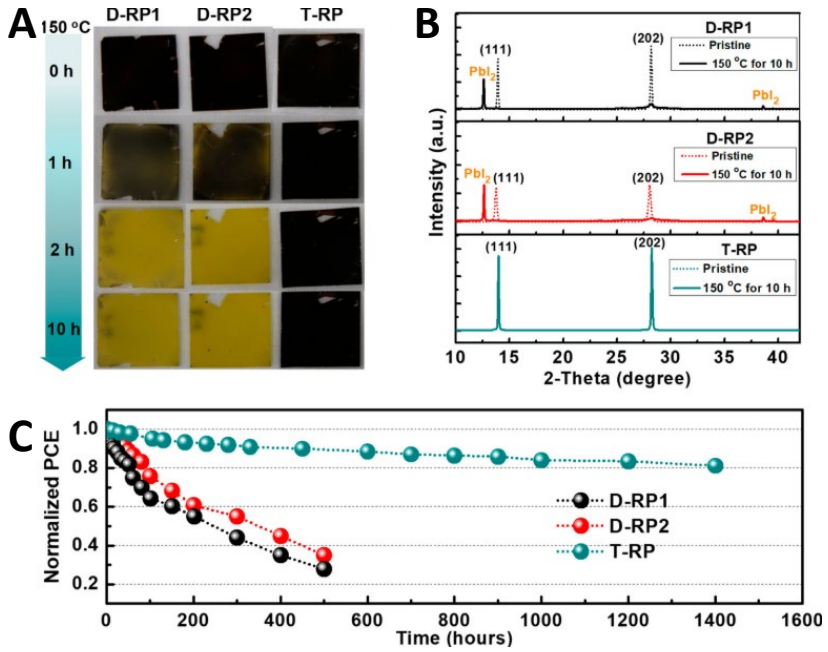
Multiple Data Presentation – Separate Panels



Multipanels with related data. Data in panel **(B)** were obtained from the measurements in panel **(A)** (viz, recording spectra at different times and monitoring changes in absorbance

Source: **DOI** 10.1021/jacs.6b04661

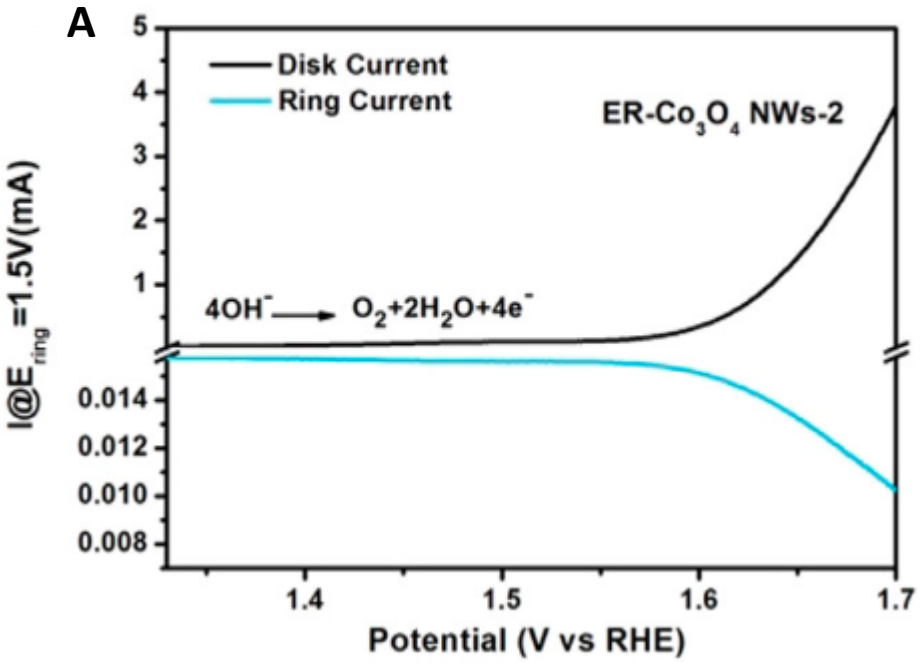
Multiple Data Presentation – Different Content



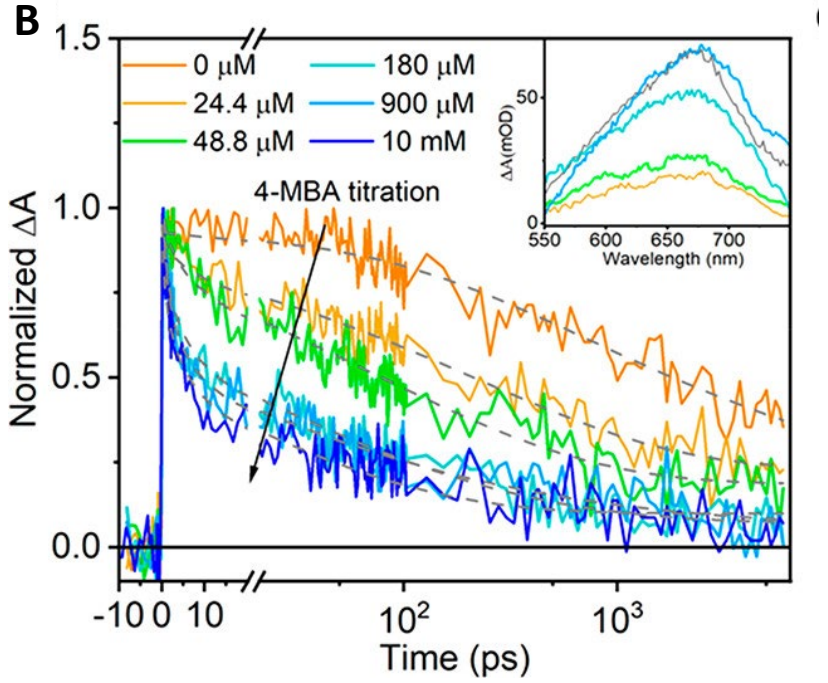
- Multiple data sets with proper legends
- All text clearly readable
- Effective presentation of data

Additional example of multiple panels presenting related data
Source: **DOI** 10.1021/acsenergylett.9b00403

Presenting Large Range of Data



- Two sets of wide range data clearly presented by using Y-axis discontinuity

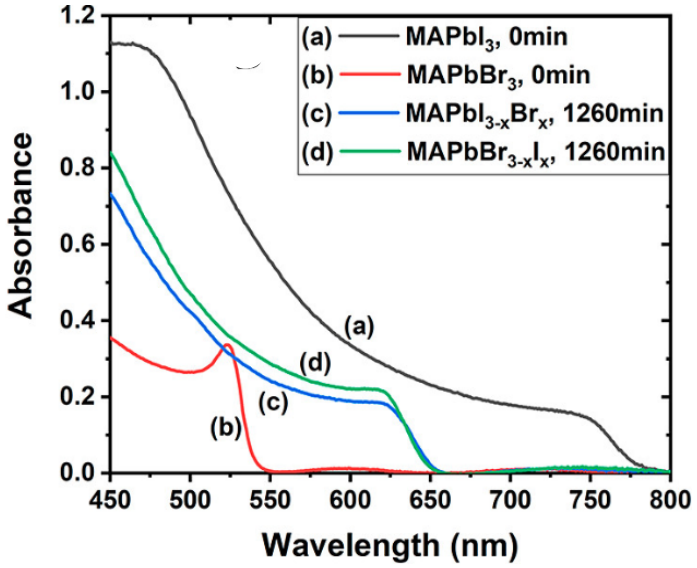


- Wide range data on X-axis presented by using of logarithmic scale and discontinuity (Typically only one is needed)

Figure 22. Present a large range of data values using a logarithmic and/or discontinuous scale
Sources: **DOI** 10.1021/acsenergylett.8b01974, **DOI** 10.1021/jacs.9b04556

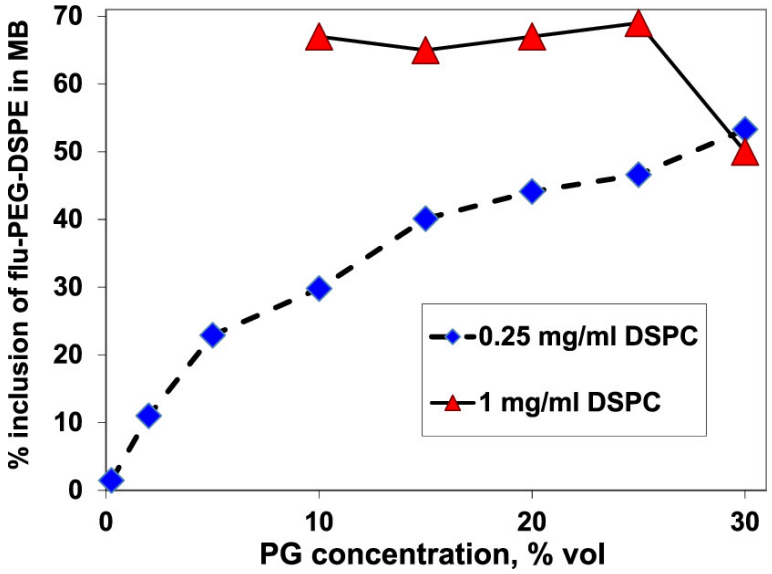
Data Identification

A



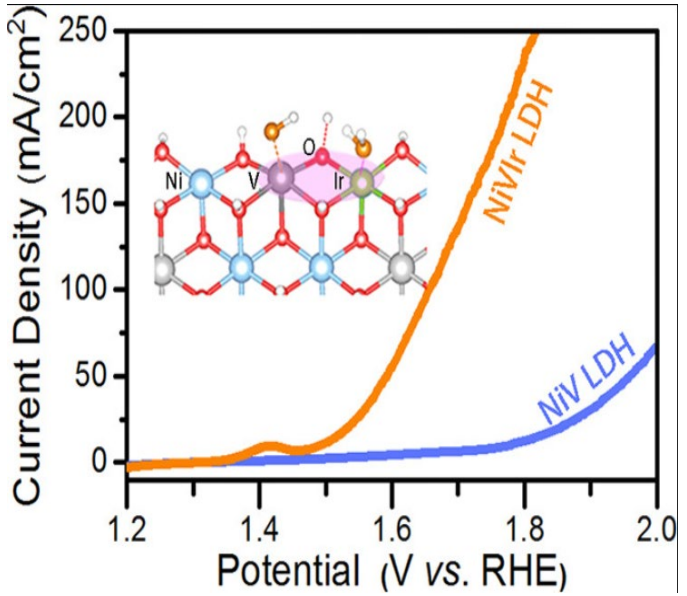
Legend

B



Key

C

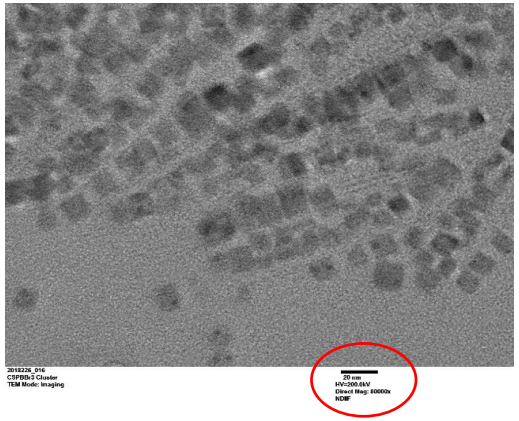


Label

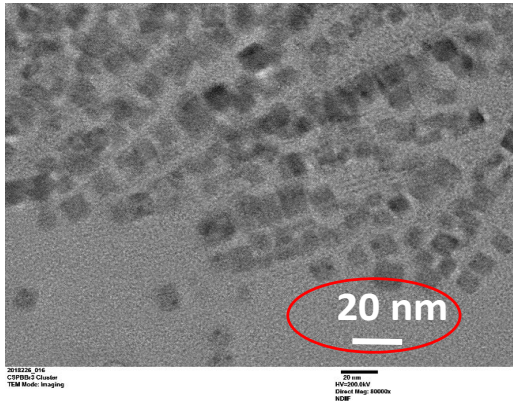
Identifying data sets using legends, keys and labels. Three different ways to identify individual data sets and it avoids defining sets with colors.
Sources: **DOI** 10.1021/acsenergylett.9b01280, **DOI** 10.1021/acs.langmuir.8b03551, **DOI** 10.1021/acsenergylett.9b01252

Microscopy Images

A



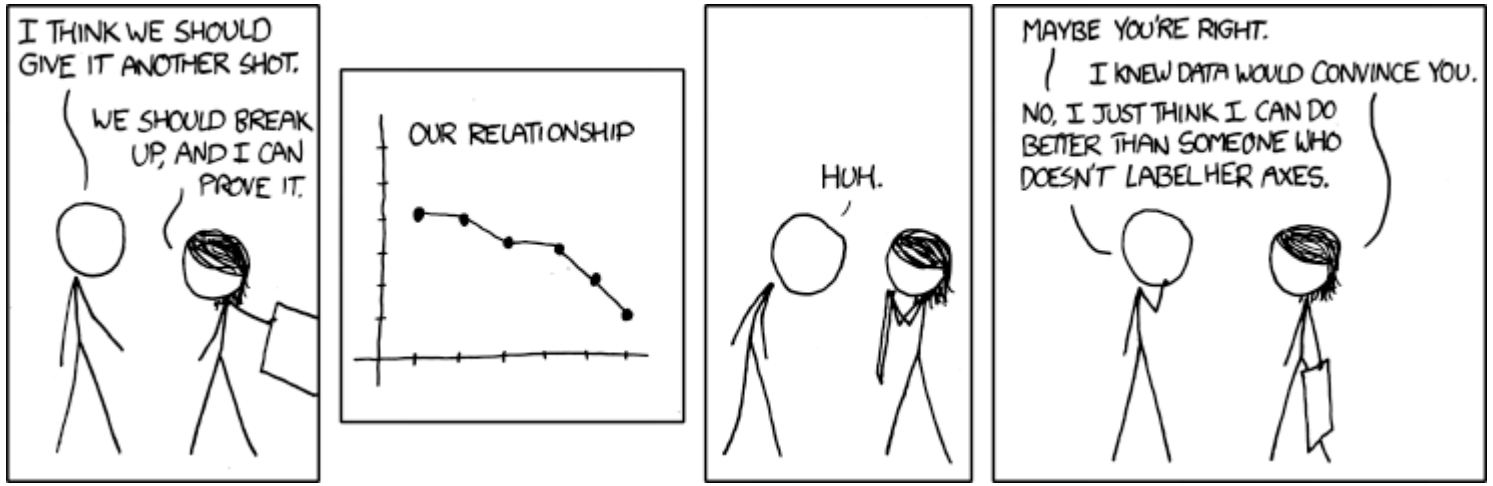
B



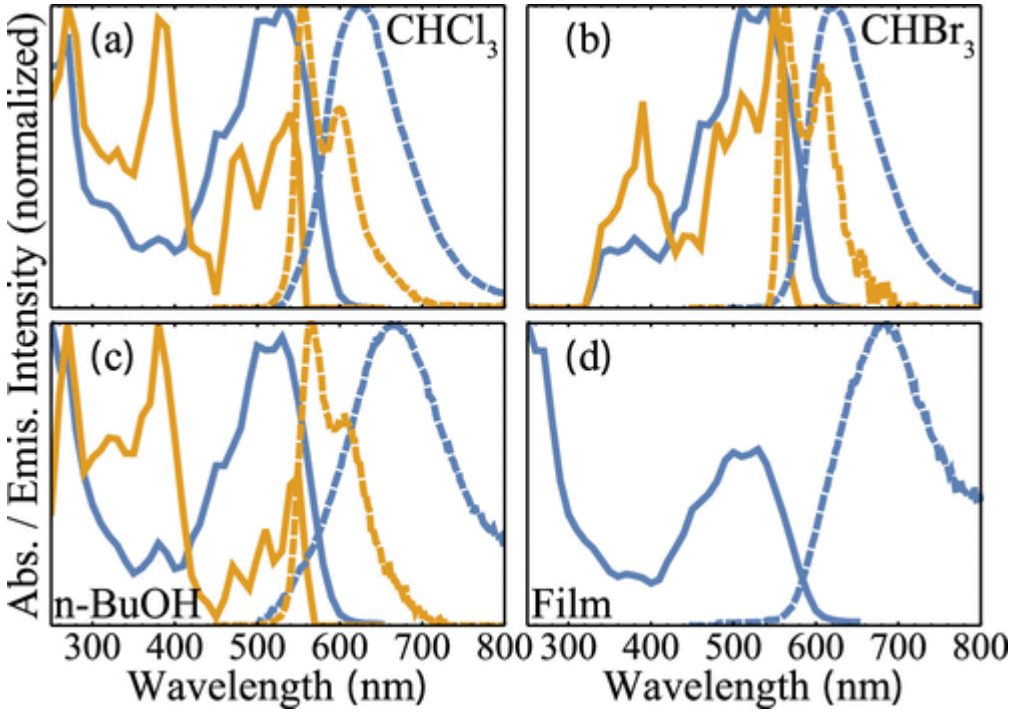
- The instrument-generated description is hard to read (A). A more legible scale bar was added (B)
- Alternatively, the scale bar dimension could be included in the caption.

Legible scale bars are essential in micrographs and images
Source: **DOI** 10.1021/acsenergylett.8b00380

What Happens when you do not pay attention?

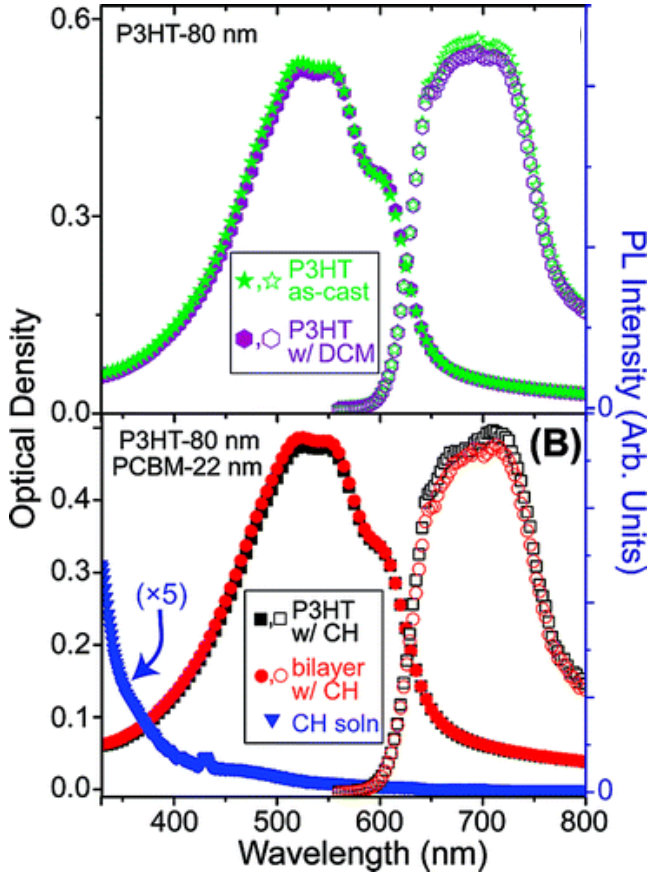


A



- Two different properties (absorption & emission) are presented on the same Y-axis
- It is not clear what is the normalization factor or how these traces were normalized

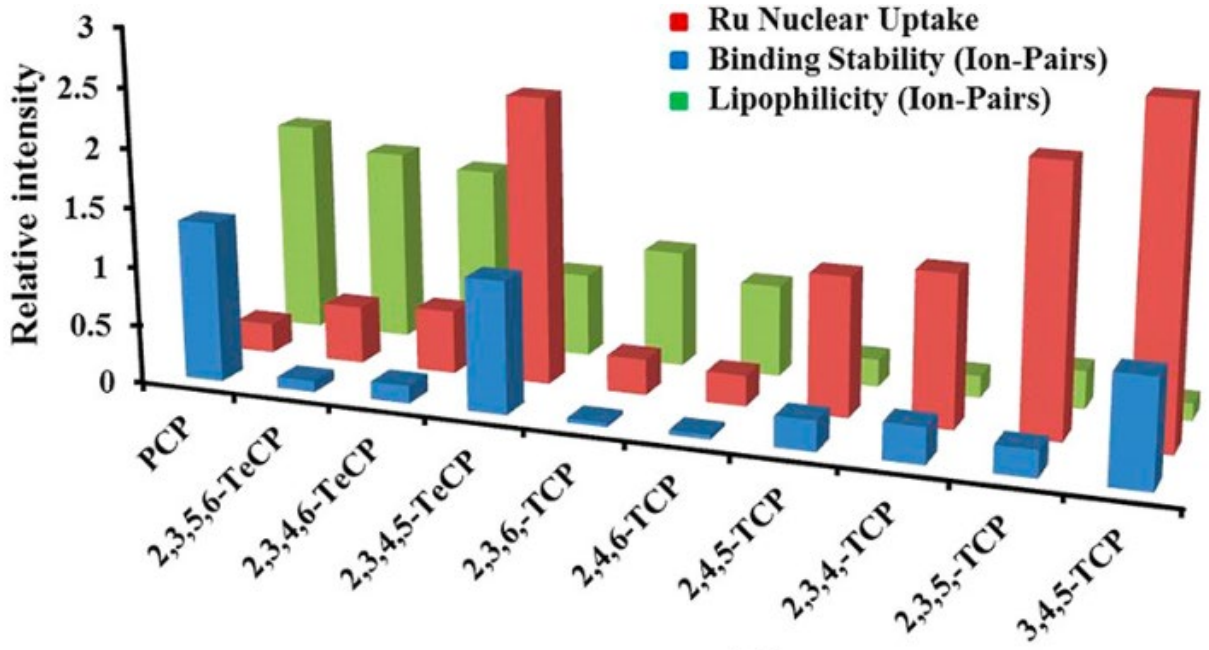
B



- Absorbance and emission scales correctly represented on two different Y- axis
- Spectra are distinguishable

When to use an X-Y-Y plot rather than an X-Y plot. **(A)** Single Y-axis to represent different properties **(B)** Good use of dual Y-axes with distinguishable spectra.
Sources: **DOI** 10.1021/acs.jpcc.8b11493**, DOI:** 10.1021/jp9050897

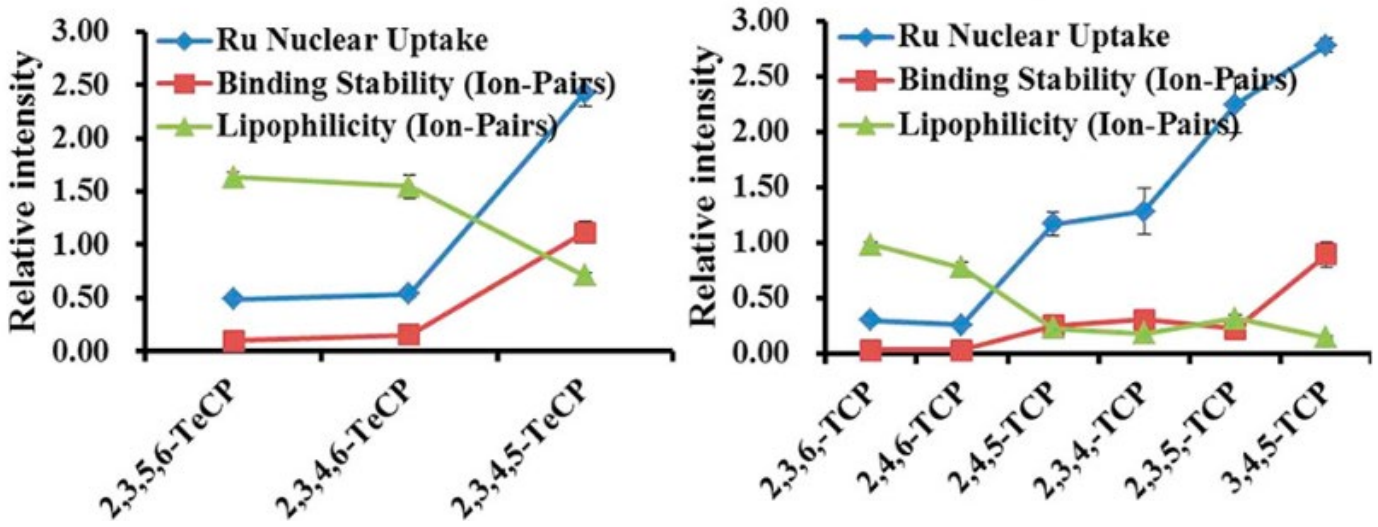
A



Panel A

- Aesthetically pleasing with distinguishable colors
- Bar diagram is appropriate and presents a nice comparison
- The offset angle, however, makes it difficult to estimate the magnitude of the bars

B

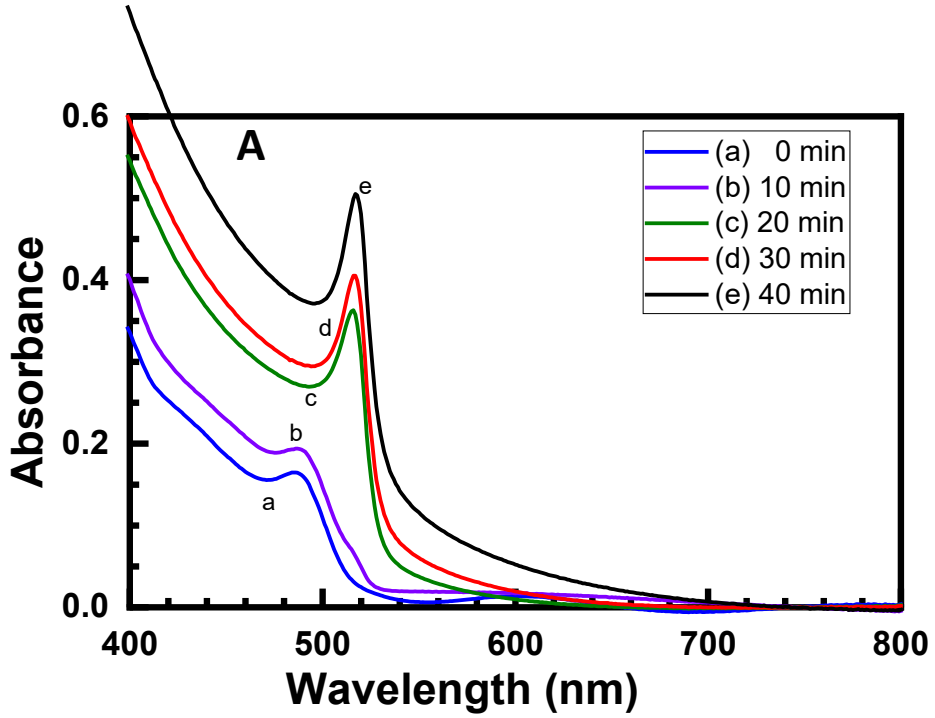


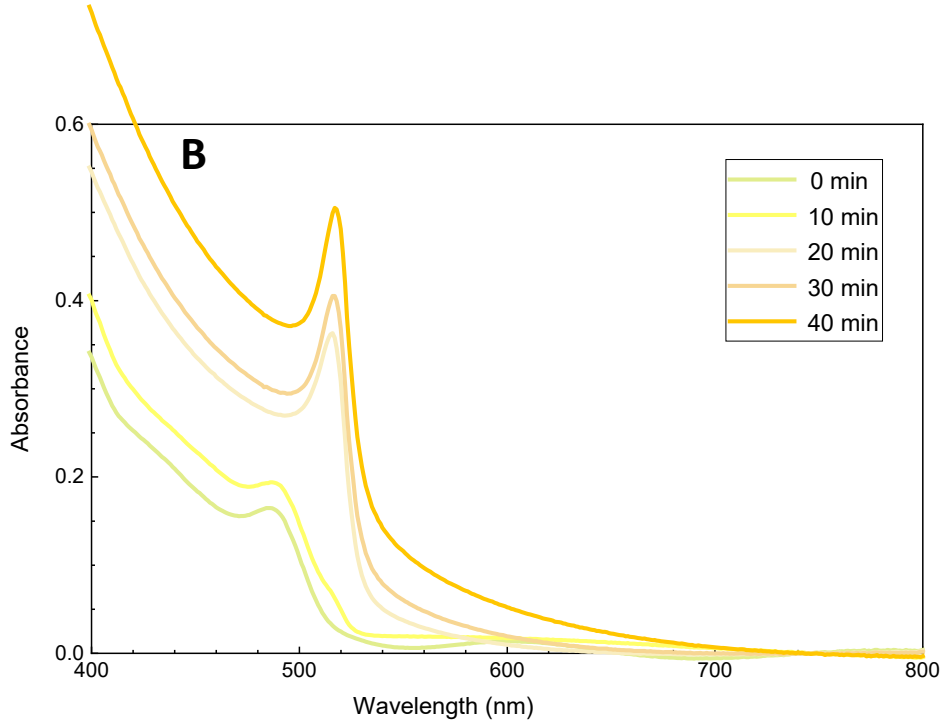
Panel B

- Color code used inconsistently between panels A and B
- Trendlines are misleading since there is no causality between the X- and Y-axes (i.e., there should be no connecting lines)

Good use of color, although inconsistent choice of color codes between panels

Source: **DOI** 10.1021/acs.jpclett.9b01225

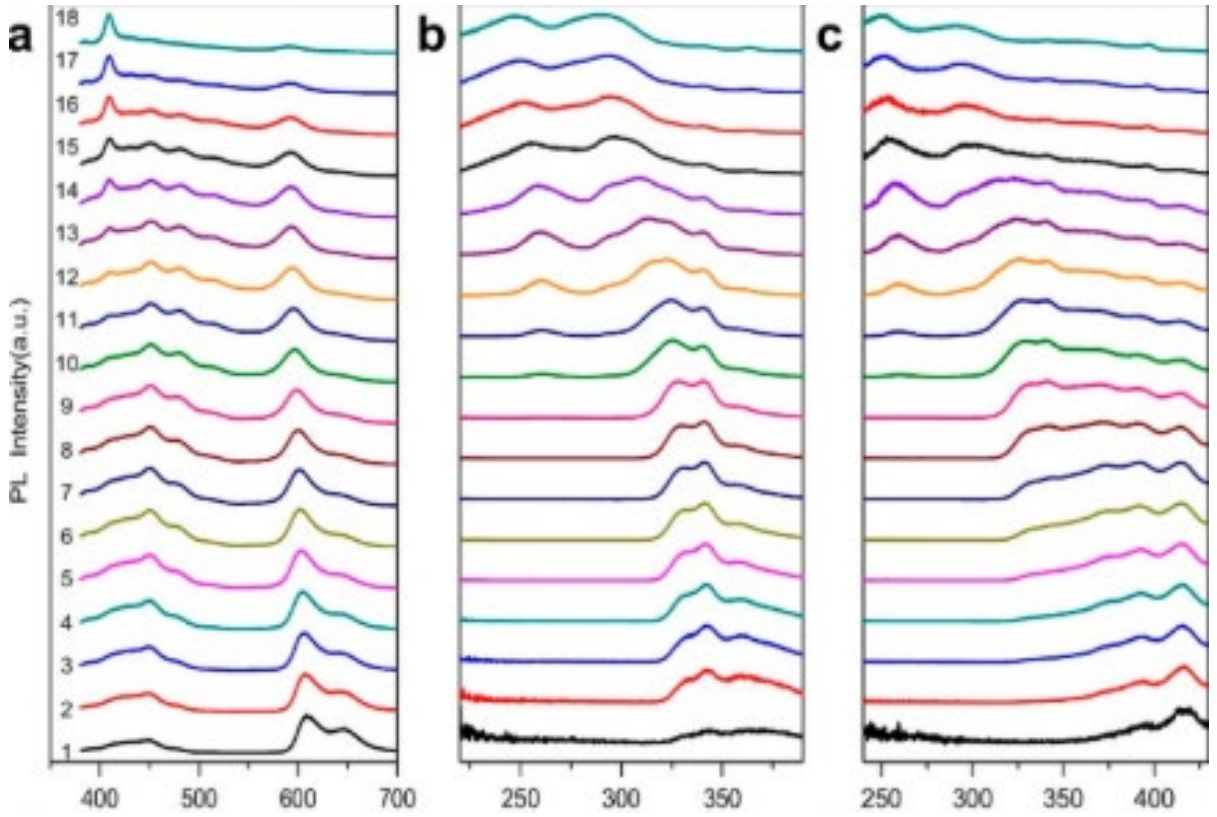




- Bold and vibrant colors with individual labels makes traces easily identifiable
- Large fonts are easy to see
- Thick axis lines with well marked major and minor ticks

- Light colors makes the data difficult to differentiate
- Small fonts and thin lines are not helpful
- Colors too similar to distinguish

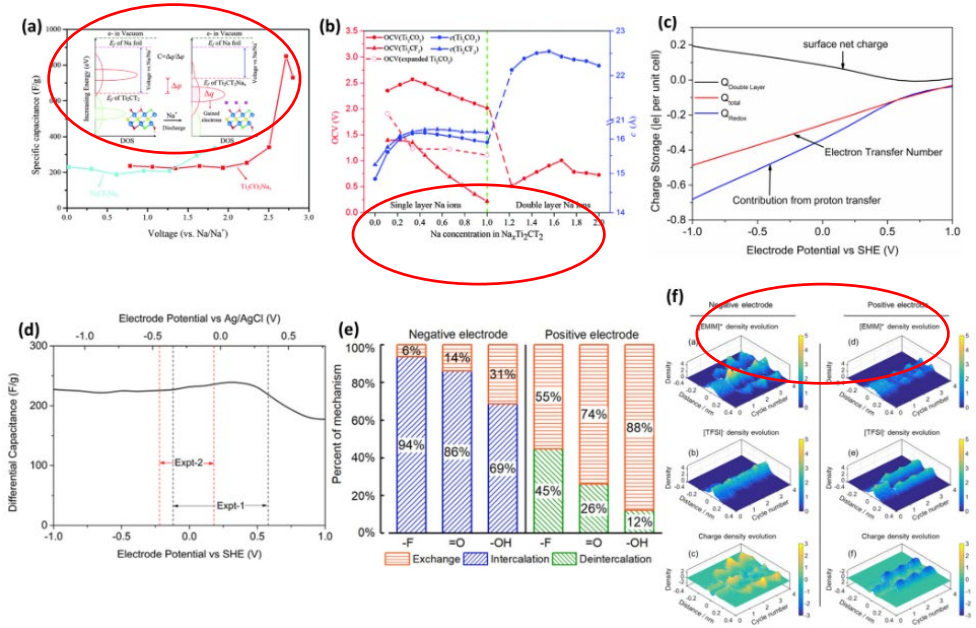
Why the choice of colors matters. **(A)** Selection of vibrant, distinguishable colors makes the data stand out. **(B)** Very similar colors make the data blend together.
Source, panel A: **DOI** 10.1021/acsmaterialslett.9b00001



- Good collection of spectra with distinguishable colors
- Spectra not clearly identified or quantified

These multipanels are not self-explanatory. (You need to refer to the manuscript text to interpret them.) Source: **DOI**: 10.1021/acs.jpclett.9b01575

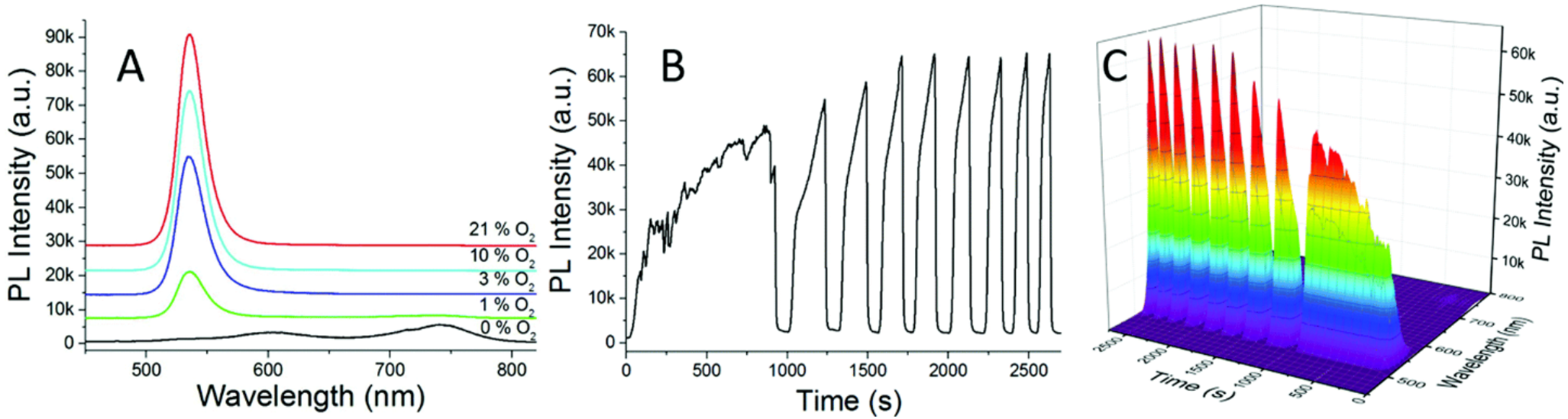
What happens when you cram in too many panels with limited readability?



- Multipanels with unreadable data sets. Insets and additional panels make it difficult to comprehend
- Multipanels do not serve the purpose of communicating results with clarity

Multipanel graphic viewed at its published size. Can you read this without magnification?
Source **DOI:** 10.1021/acsami.9b00439

Will presenting same data in different forms be useful?

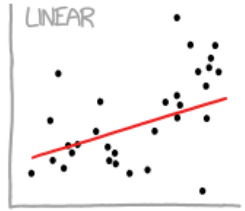


- Panel C is from the same data set presented in panel B. It does not add any additional scientific information.
- Panel A y-axis – Relative units on Y-axis would have been more relevant. The shifted scale makes it difficult to gauge the changes.

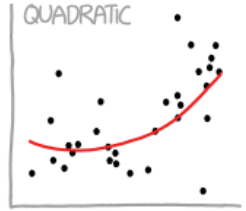
Panels **(A)** and **(B)** present related data. Panels **(B)** and **(C)** do not provide any significantly different information.

Source: **DOI** 10.1039/C9TC02635E

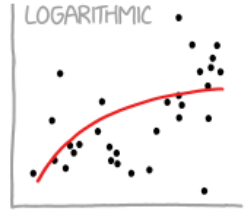
CURVE-FITTING METHODS
AND THE MESSAGES THEY SEND



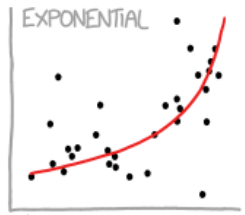
"HEY, I DID A REGRESSION."



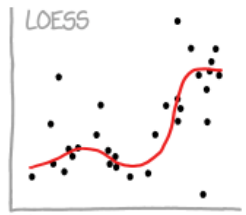
"I WANTED A CURVED LINE, SO I MADE ONE WITH MATH."



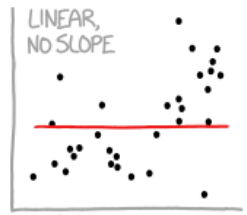
"LOOK, IT'S TAPERING OFF!"



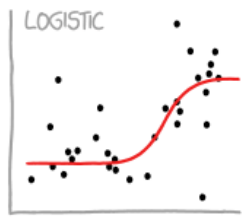
"LOOK, IT'S GROWING UNCONTROLLABLY!"



"I'M SOPHISTICATED, NOT LIKE THOSE BUMBLING POLYNOMIAL PEOPLE."

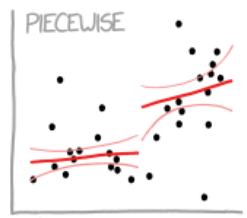


"I'M MAKING A SCATTER PLOT BUT I DON'T WANT TO."

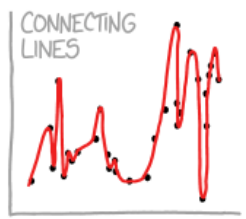


"I NEED TO CONNECT THESE TWO LINES, BUT MY FIRST IDEA DIDN'T HAVE ENOUGH MATH."

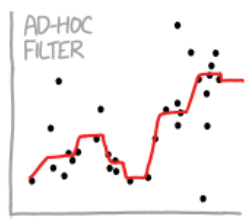
"LISTEN, SCIENCE IS HARD. BUT I'M A SERIOUS PERSON DOING MY BEST."



"I HAVE A THEORY, AND THIS IS THE ONLY DATA I COULD FIND.



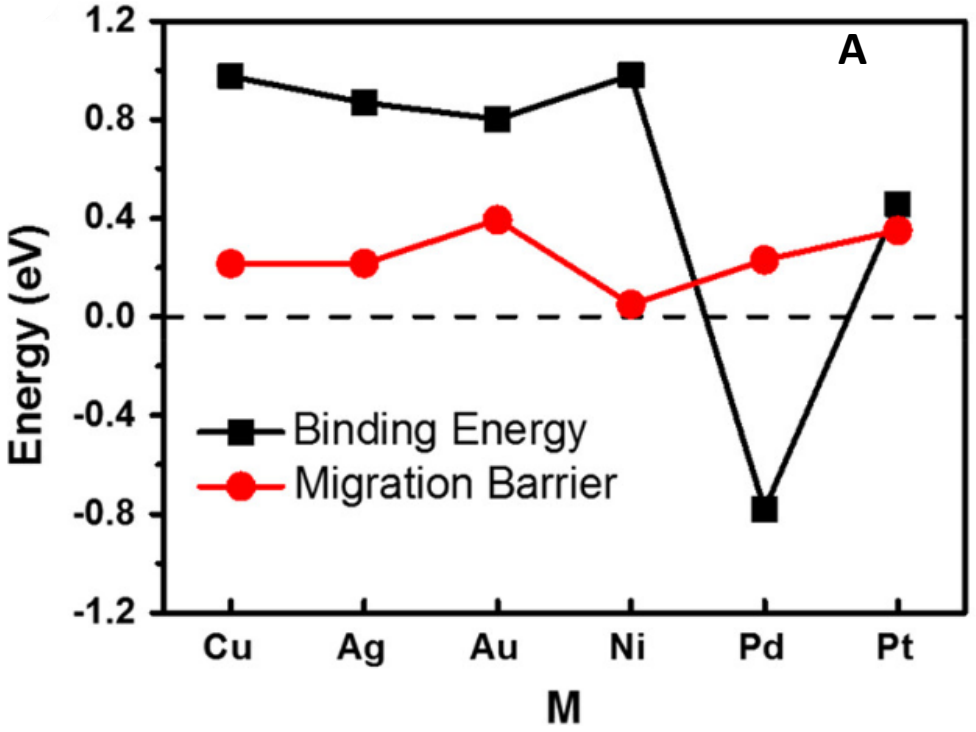
"I CLICKED 'SMOOTH LINES' IN EXCEL."

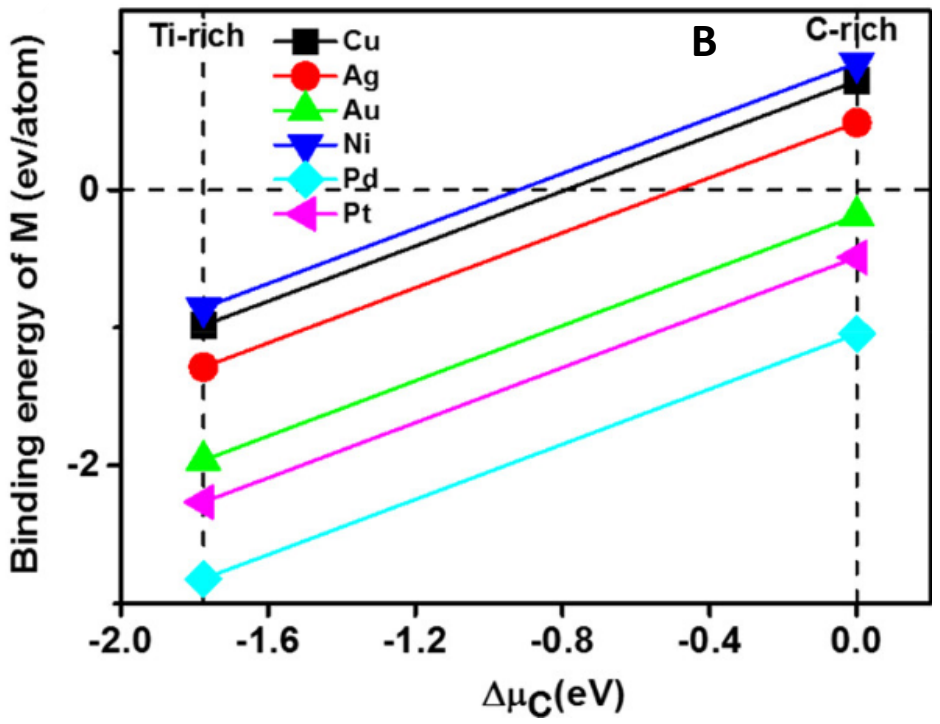


"I HAD AN IDEA FOR HOW TO CLEAN UP THE DATA. WHAT DO YOU THINK?"

"AS YOU CAN SEE, THIS MODEL SMOOTHLY FITS THE– *WAIT NO NO DON'T EXTEND IT AAAAAA!!*"

When not to use a trend line or a fit



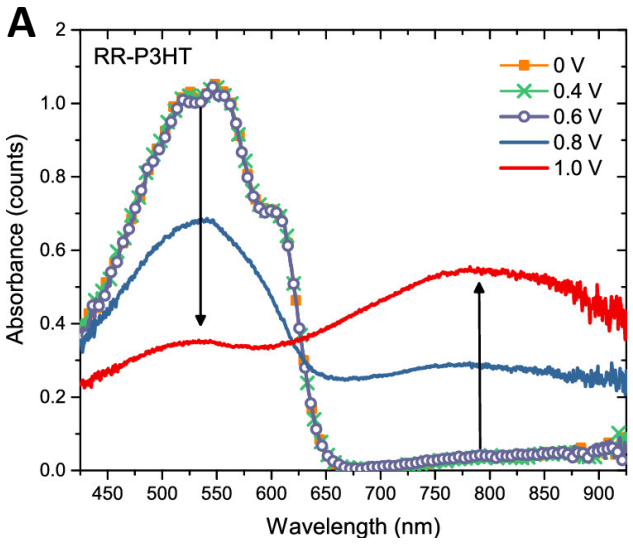


- No causality between X- and Y-variables (Are the lines guides-to-the-eye?)
- Data better presented as a bar chart

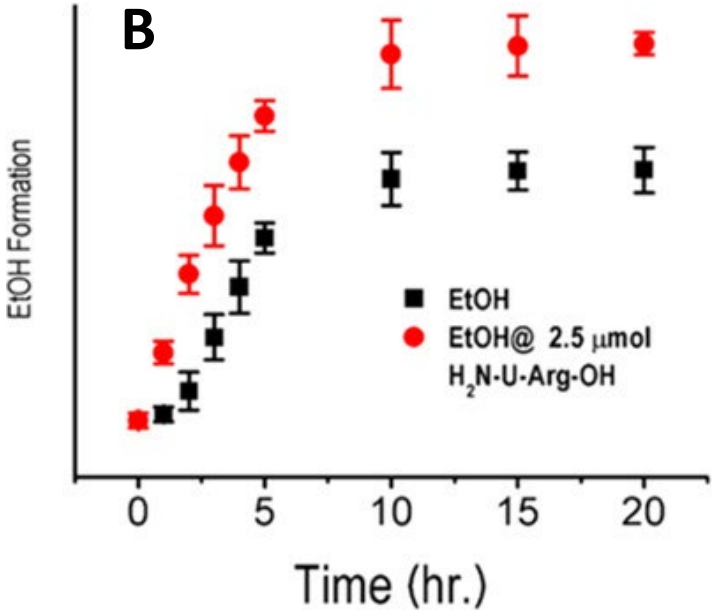
- A minimum of three data points are needed before drawing a linear trendline

(A) Incorrect presentation of data since it lacks causality and **(B)** "fits" that are not really fits.
Source: **DOI** 10.1021/acsenergylett.8b01942

Why use of proper units is important



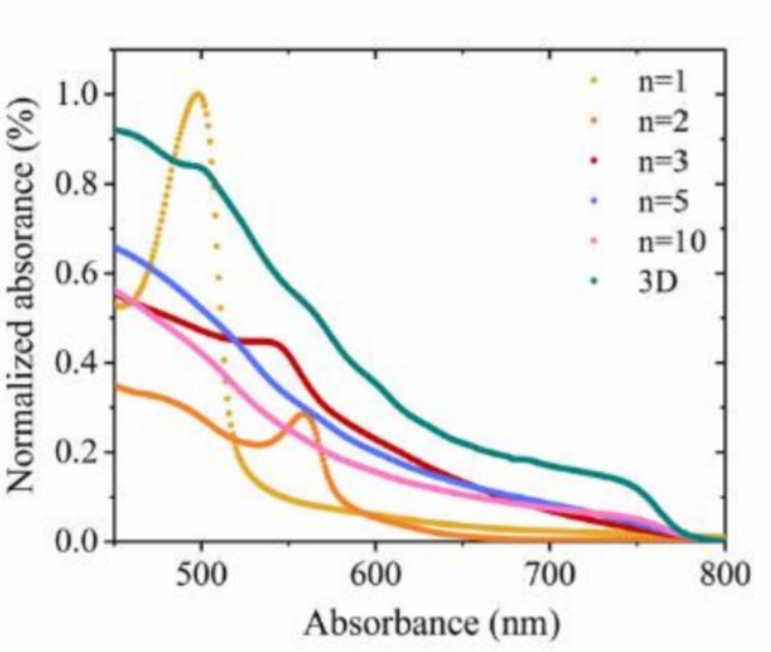
- Counts is not the right unit to represent absorbance
- Absorbance is unitless



- Units and scale are not expressed on Y-scale
- The data points and error bars provide no quantitative information

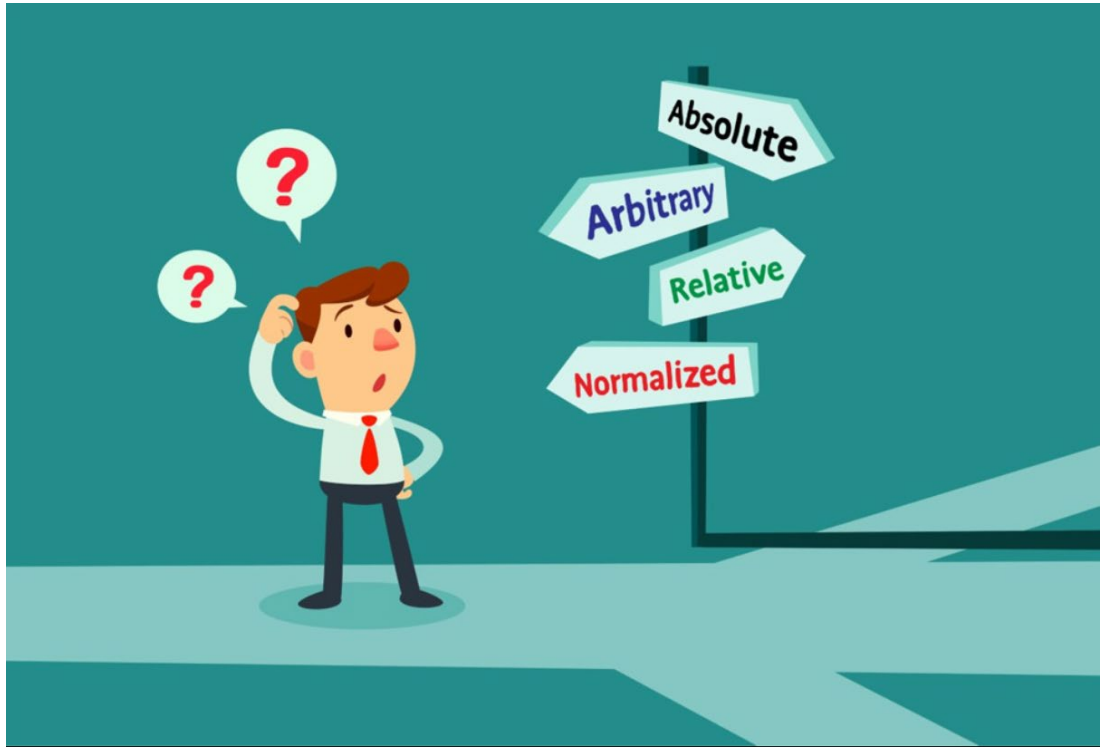
Check axis titles, units and scales for accuracy. The lack of typographical errors does not assure correctness.

Sources: **DOI** 10.1021/acs.jpcc.8b09706, **DOI** 10.1021/acsomega.9b01260



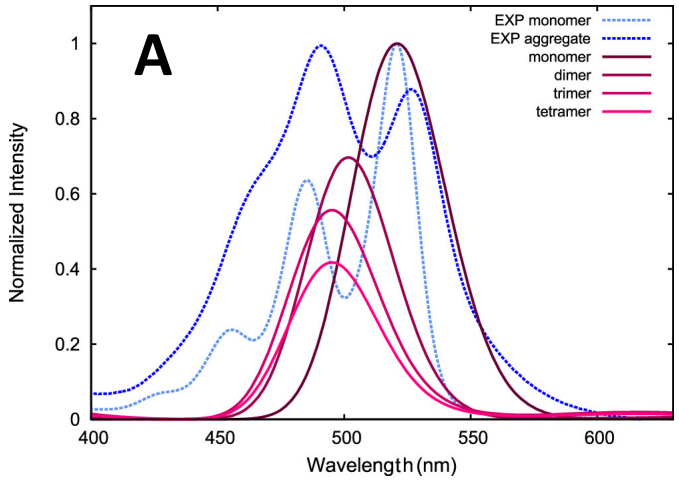
- Normalized units are unitless
- Wrong X-axis title

DOI: 10.1021/acs.nanolett.9b00387

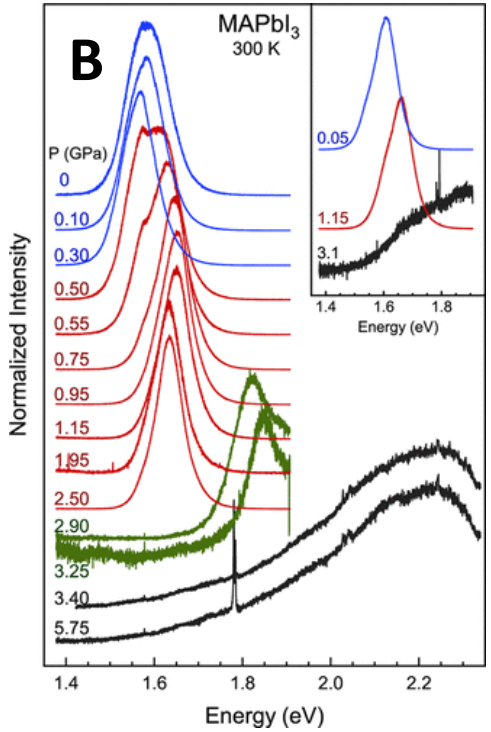


Am I the only one confused about these units?

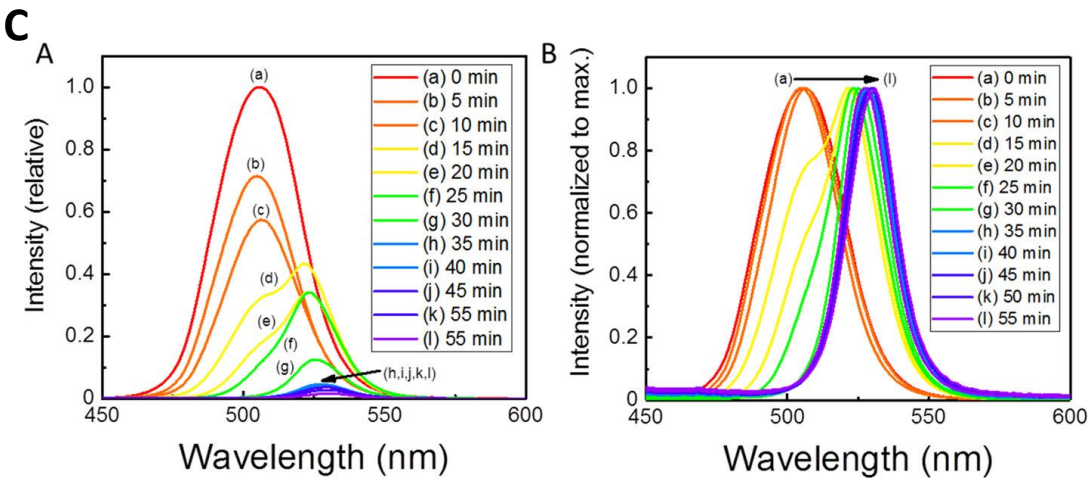
Getting the units right is not always easy.
Source: **DOI** 10.1021/acsenergylett.9b01571



- The Y-axis representation of “Normalized intensity” does not apply to all traces (Either all traces should be normalized to a constant intensity value or the Y-axis should be labeled with Intensity (arbitrary or relative units)



- It is not clear how these spectra are normalized
- Offset Y-axis makes it difficult to compare spectra
- Inset is missing Y-axis title

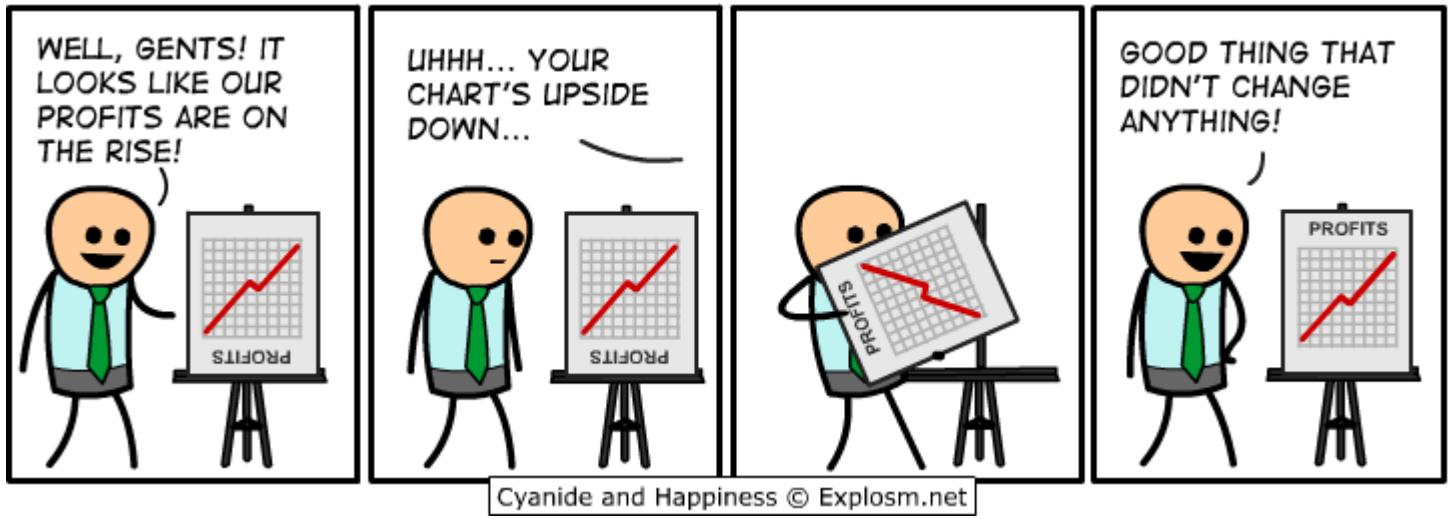


- Correct use of Y-axis units
- Panel A represents relative units to compare the intensity
- Panel B displays normalized intensity to compare peak shift

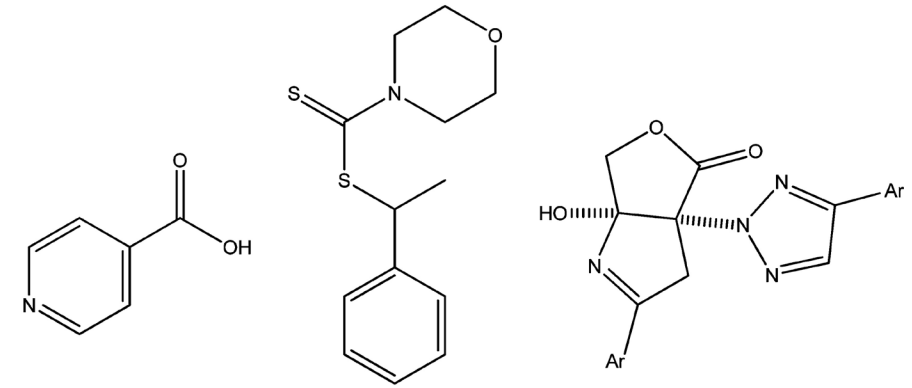
The word “normalized” is frequently misused.

Sources: **DOI:** 10.1021/acs.jpcc.9b00494, **DOI** 10.1021/acs.jpcc.8b05188, 10.1021/acsmaterialslett.9b00001

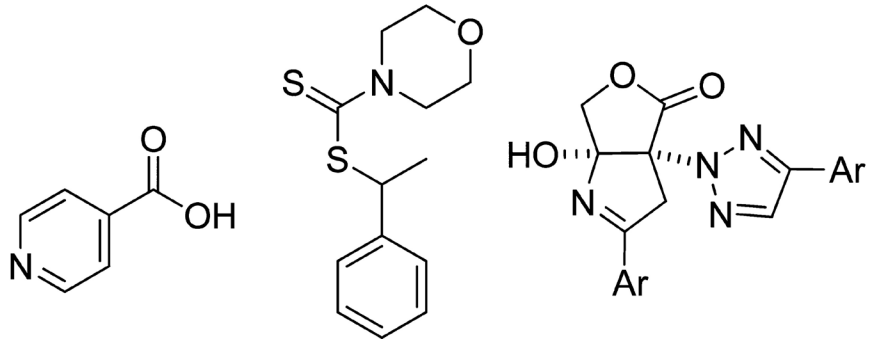
Other Important Considerations



Default format, “thin” double bonds, small font



ACS Catalysis format

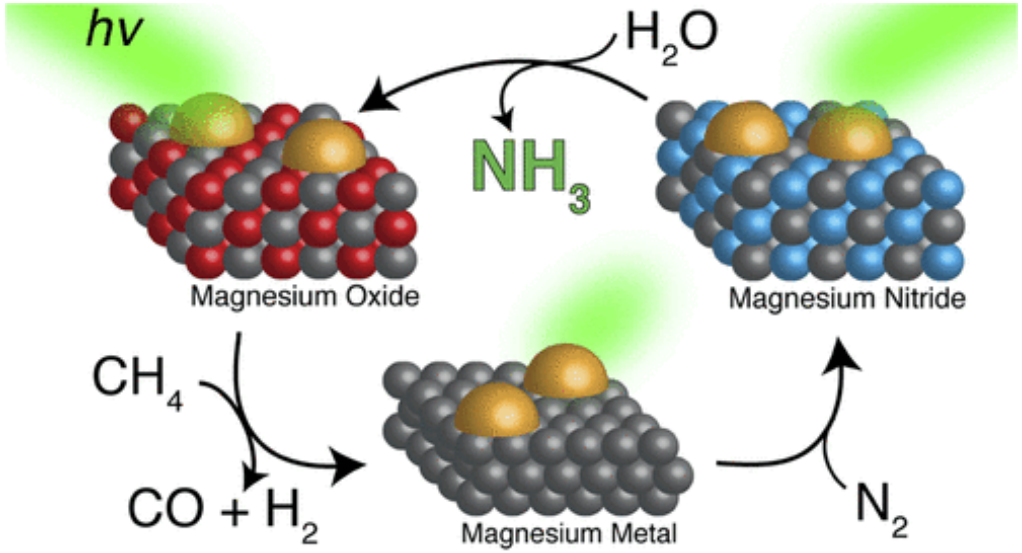


Chemical structures drawn with ChemBioDraw. The lower panel was created using *ACS Catalysis* format, increasing the clarity

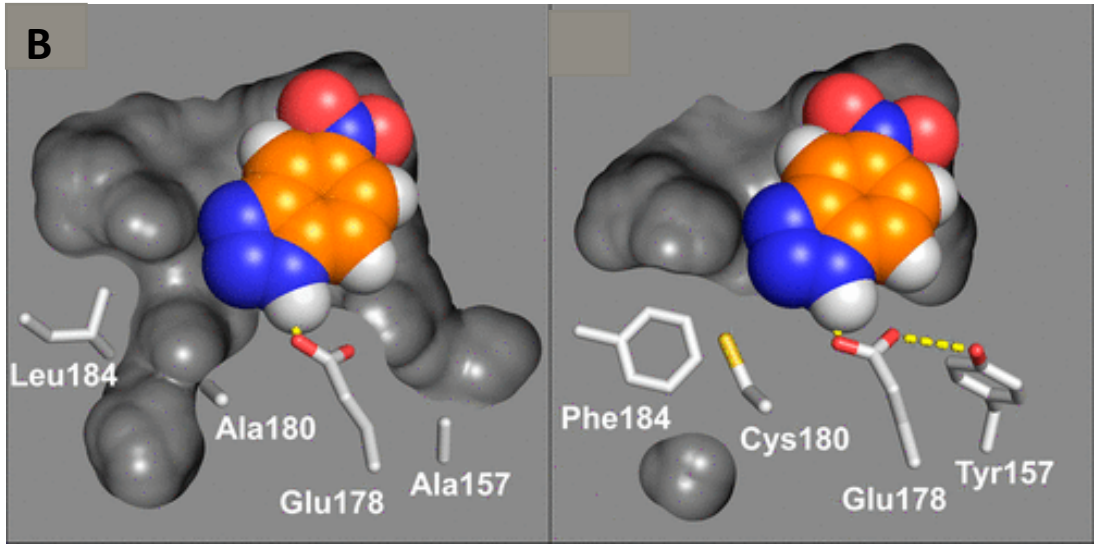
Source: **DOI** 10.1021/cs400678e

Schemes and Illustrations

A

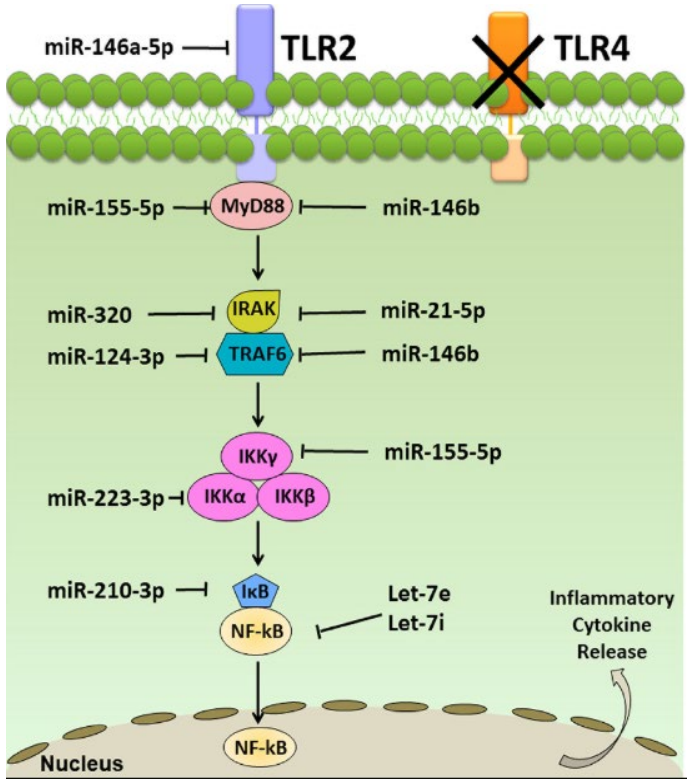


B

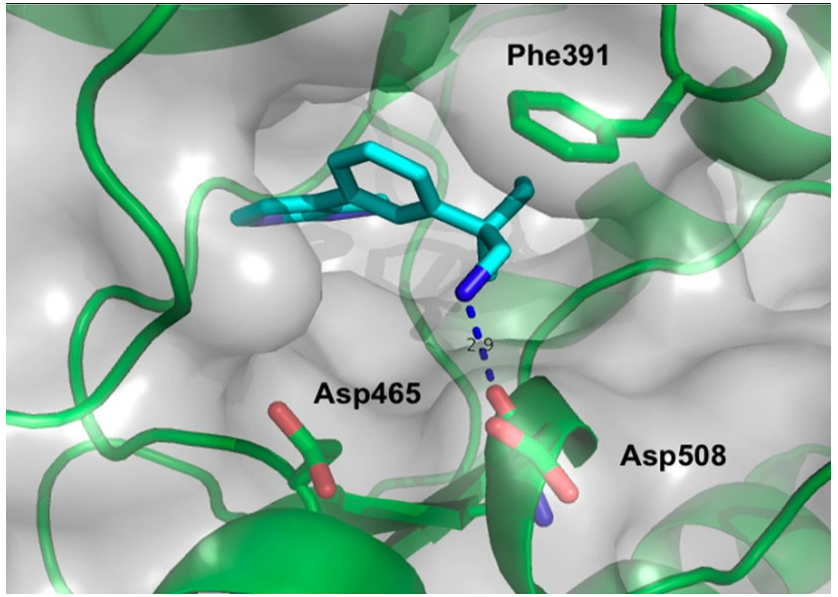


Good use of color and visualization in schemes and illustrations.
Sources: **DOI** 10.1021/acsenergylett.9b00860, **DOI** 10.1021/jacs.9b02731

A

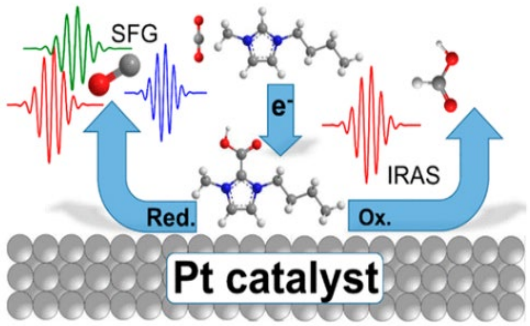


B

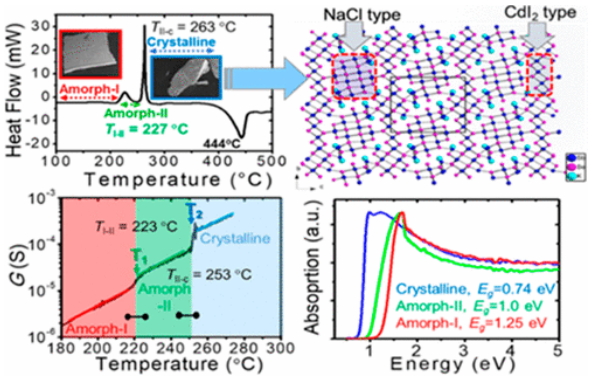


Well-drawn schemes present conceptual views to the intended disciplines' broader readership
Sources: **DOI** 10.1021/acs.est.9b00399, **DOI** acsmedchemlett.9b00134

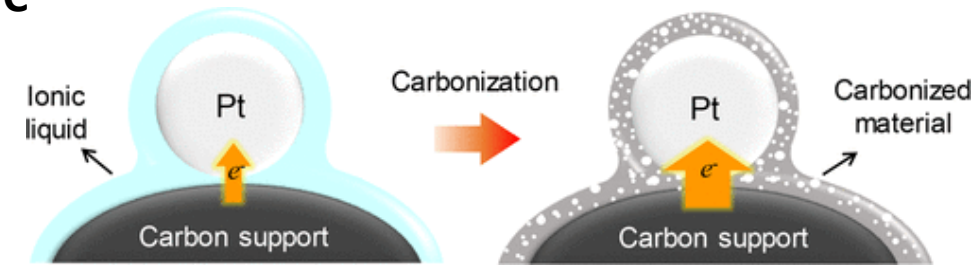
A



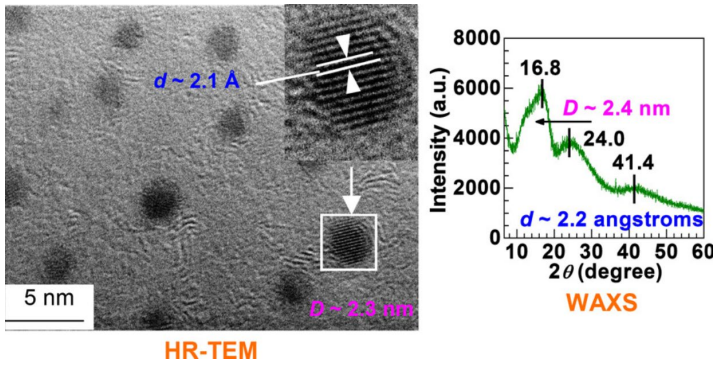
B



C

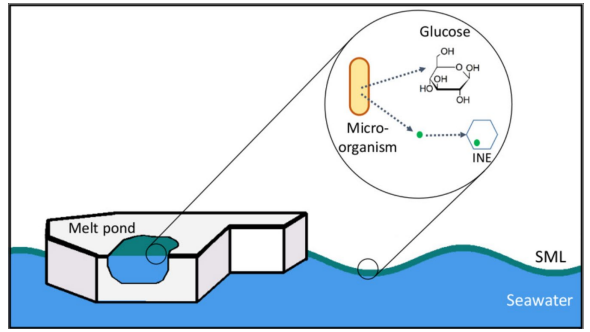


D



E

F



You be the judge to gauge the effectiveness of TOC graphics

- Can you predict what these articles are about?
- Can you even easily read the text in the graphic in order to find out?
- Are these representative of the quality of the graphics in the article?
- Which one(s) make you want to find out more the article(s)? Which was the first one to catch your eye?

Examples of Table of Contents/Abstract Graphics highlighting the importance of clarity and theme. Sources: **DOI** 10.1021/acscatal.9b01033, **DOI** 10.1021/jacs.8b05542, **DOI** 10.1021/acsaem.8b00539, **DOI** 10.1021/acsmacrolett.9b00296, **DOI** 10.1021/acsenergylett.7b00547, **DOI** 10.1021/acs.est.9b01469


I ACCIDENTALLY SENT THIS WEEK'S DATA CHARTS TO THE 3-D PRINTER.
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