Project Proposal: Database Screening for Compatible Materials with Wireless Charging

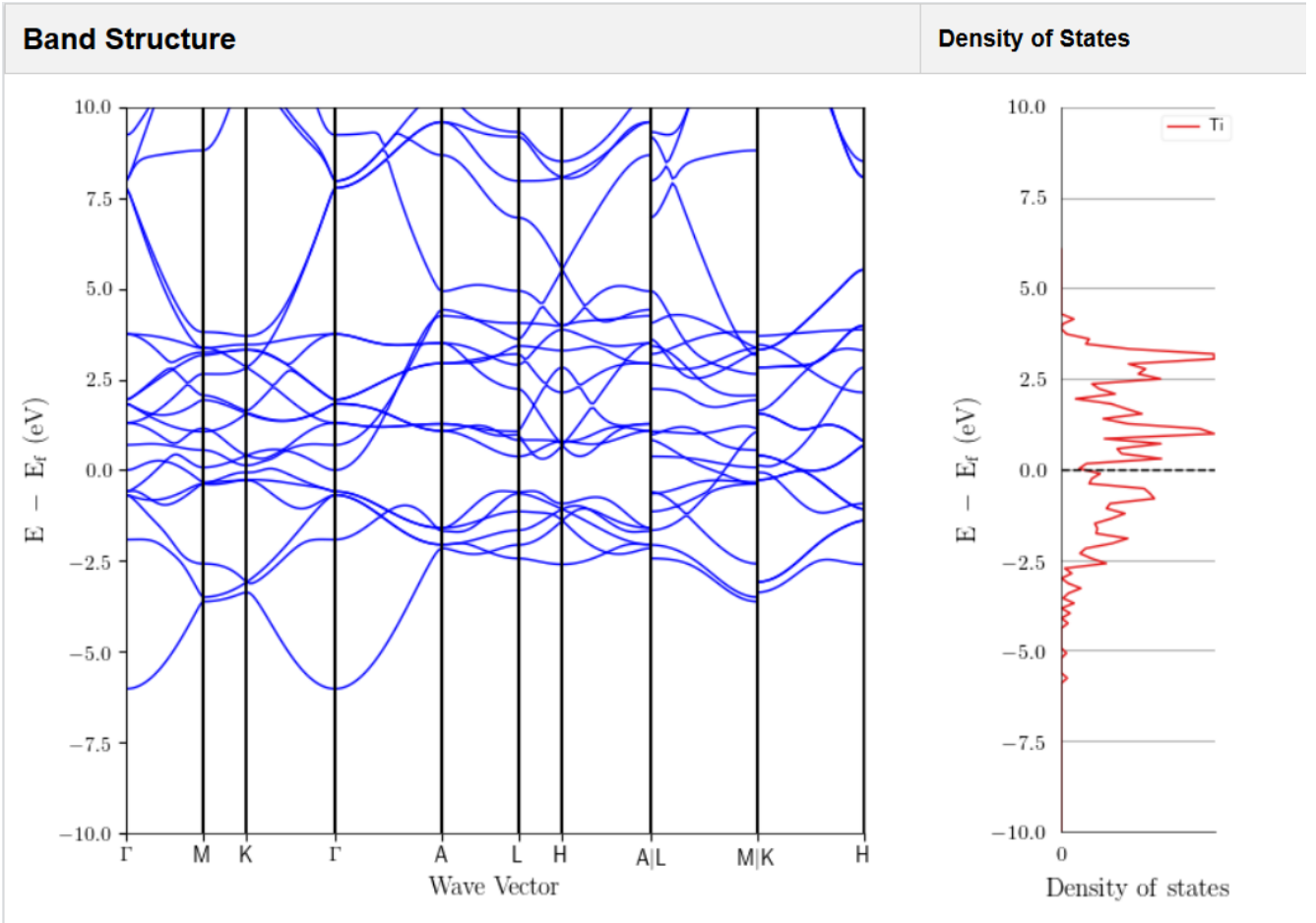
MAY 22, 2019

PANDU WISESA

Current problem

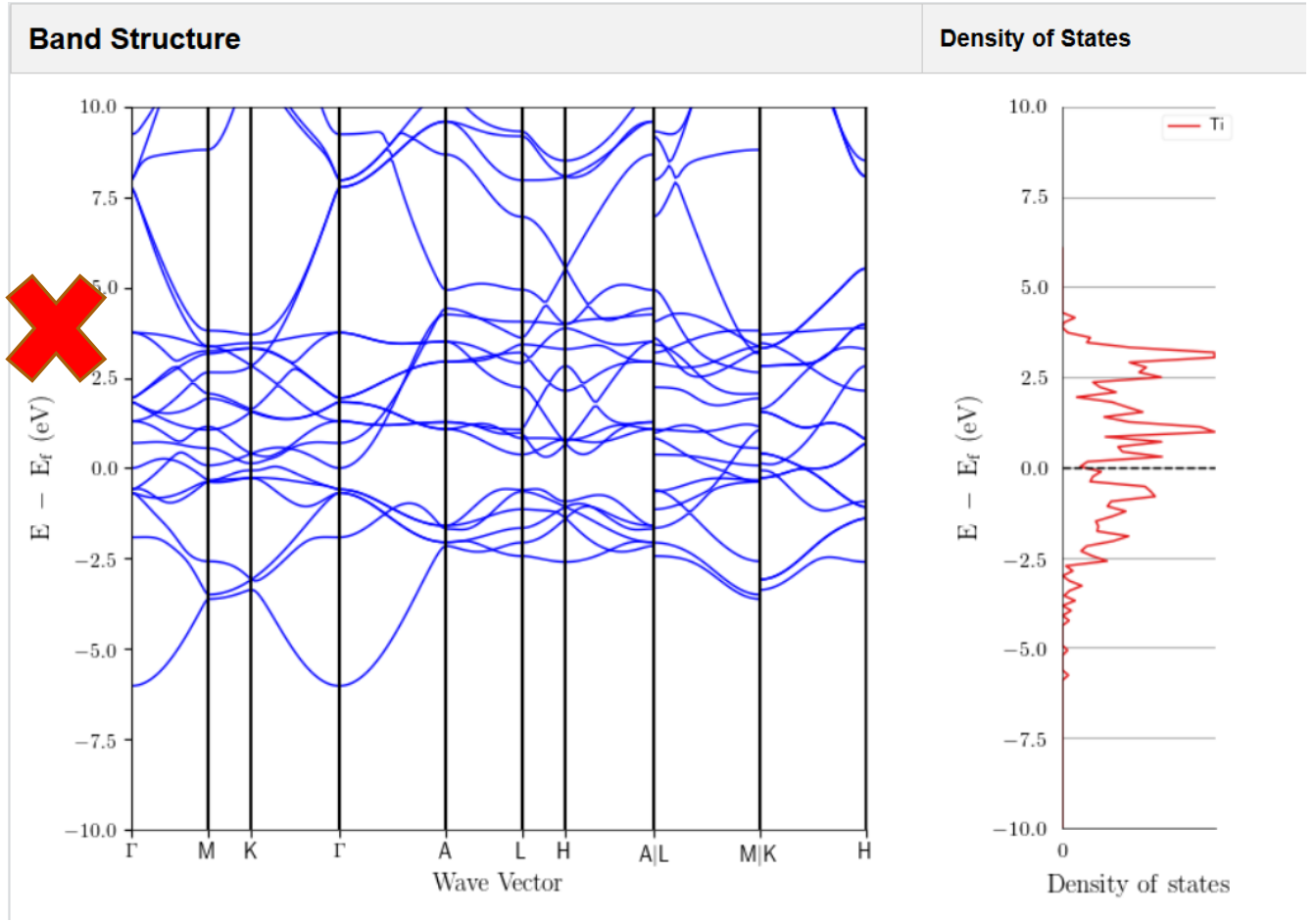
Image taken from: https://www.nbcnews.com/tech/tech-news/don-t-drop-it-shocking-repair-prices-iphone-x-n821071

Why do we use glass? - Titanium



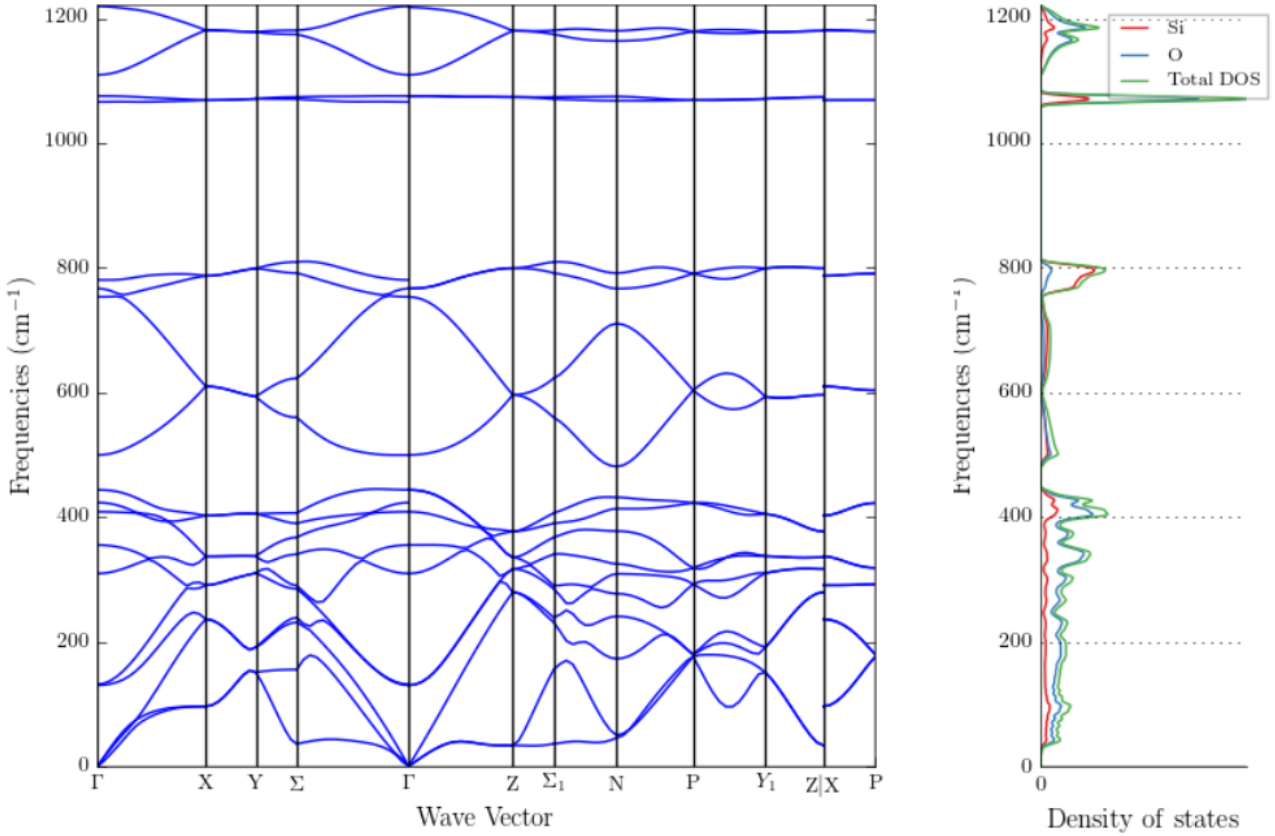
Why do we use glass? - Titanium

Device Charging Electronic Wave

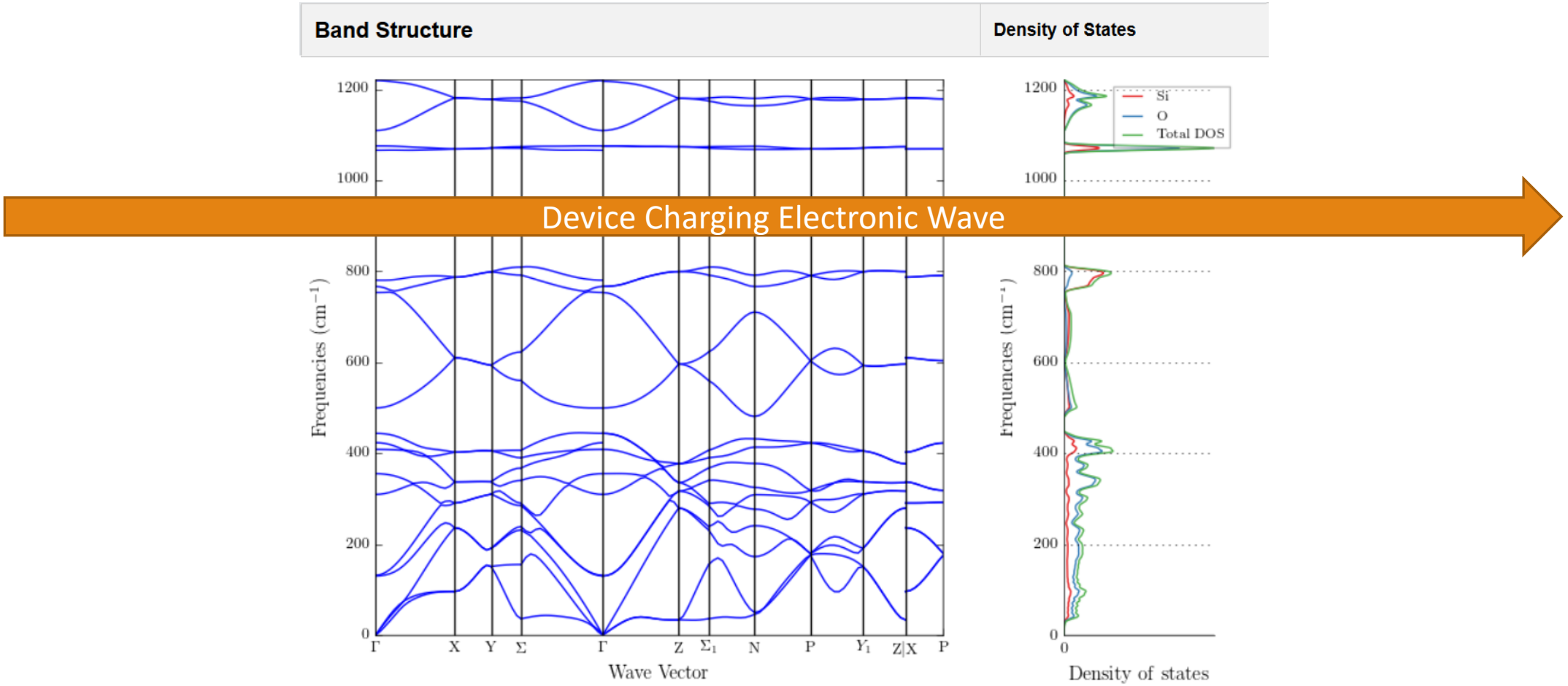


Why do we use glass? - Glass

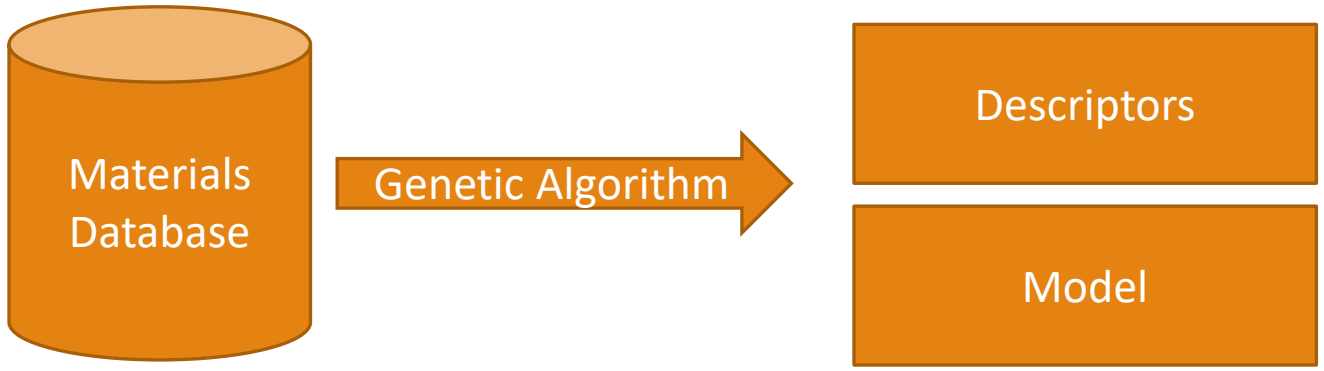
Band Structure	Density of States



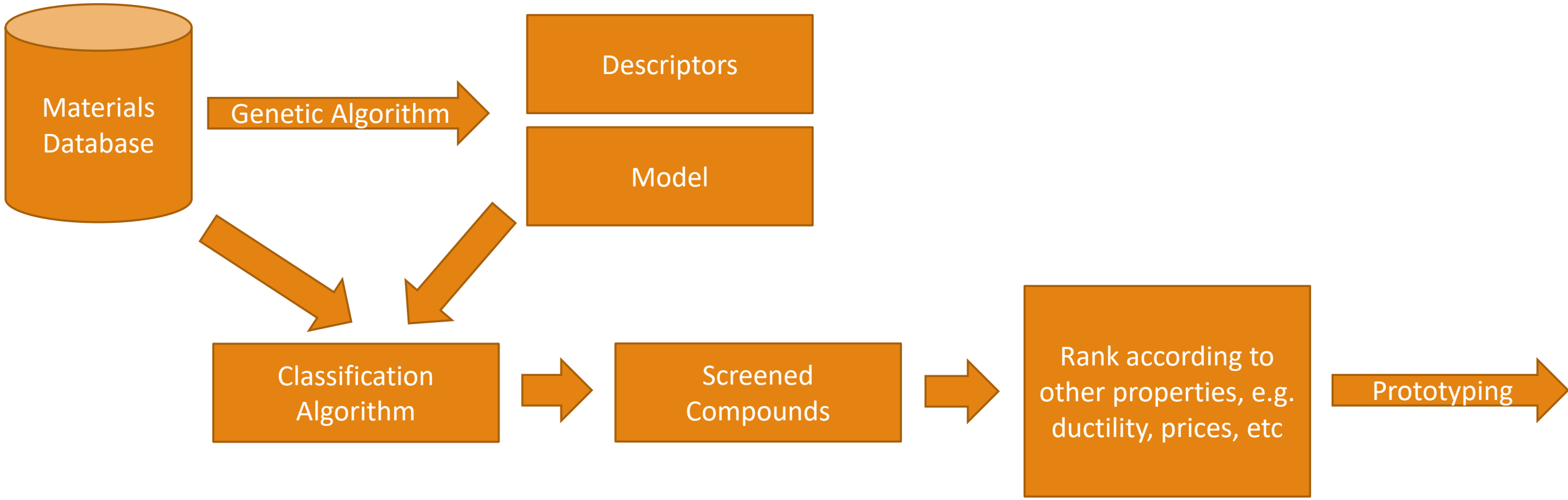
Why do we use glass? - Glass



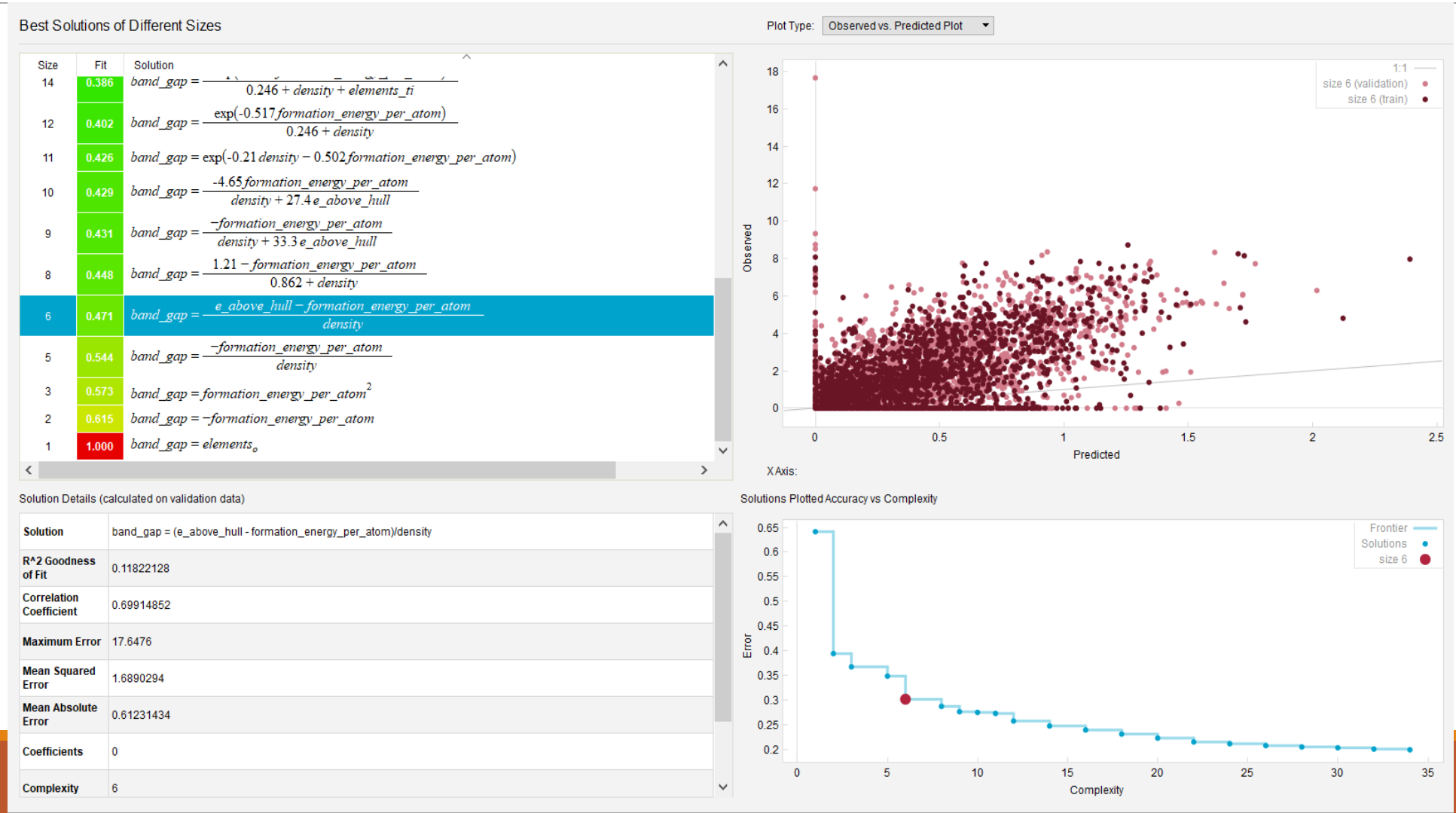
Screening Process



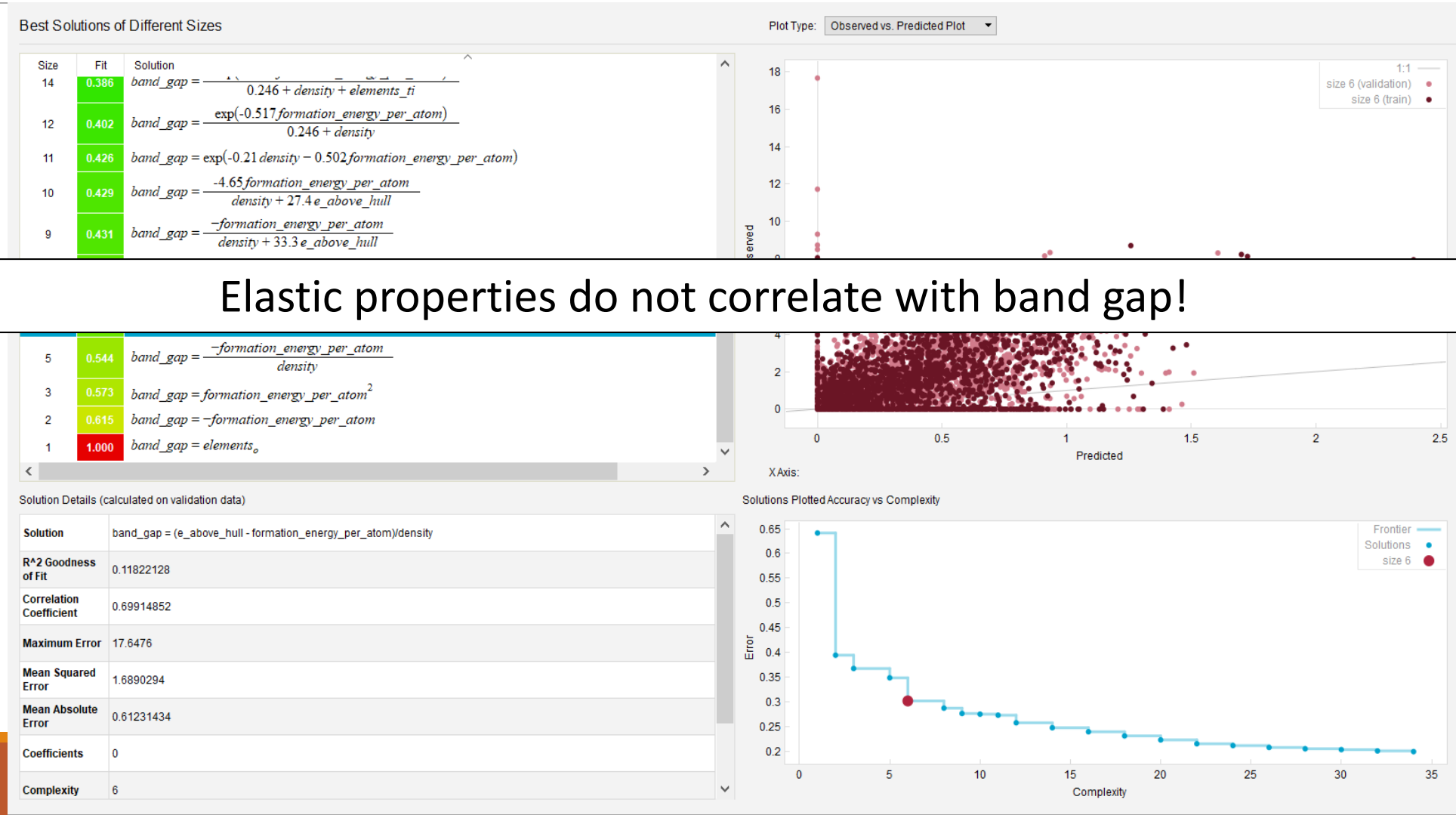
Screening Process



Adding Elastic Properties



Adding Elastic Properties



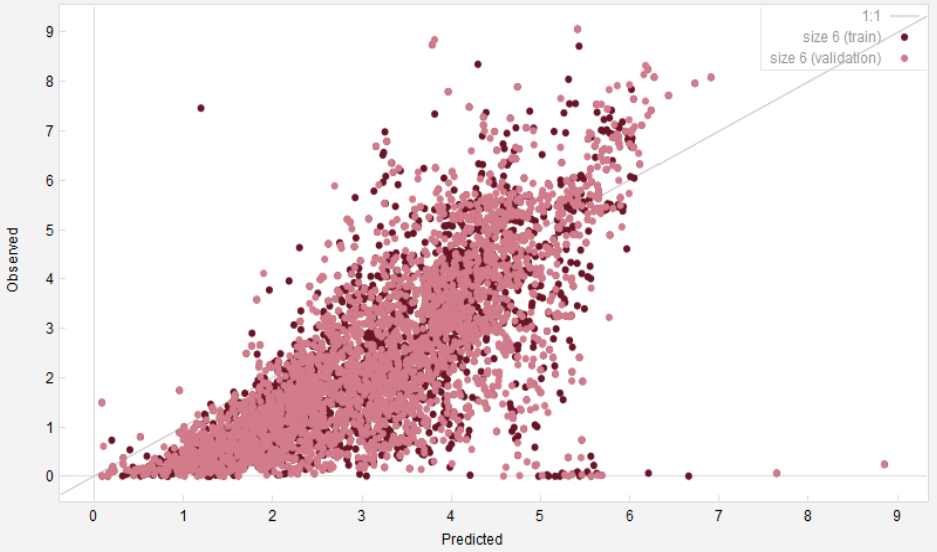
Elastic properties do not correlate with band gap!

Dataset with dielectric properties

Best Solutions of Different Sizes

Size	Fit	Solution
16	0.256	$band\_gap = \frac{3.04 + elements_h - formation\_energy\_per\_atom - elements\_mn - elements_v - 0.271}{index\_of\_refraction}$
14	0.268	$band\_gap = \frac{3 + elements_h - formation\_energy\_per\_atom - elements\_mn - 0.255\,density}{index\_of\_refraction}$
12	0.277	$band\_gap = \frac{2.81 + elements_h - formation\_energy\_per\_atom - elements\_mn - elements_v}{index\_of\_refraction}$
10	0.285	$band\_gap = \frac{3.24 + elements_h - formation\_energy\_per\_atom}{index\_of\_refraction} - elements\_mn$
8	0.301	$band\_gap = elements_h + \frac{3.3 - formation\_energy\_per\_atom}{index\_of\_refraction}$
6	0.339	$band\_gap = \frac{4.72 - formation\_energy\_per\_atom}{index\_of\_refraction}$
4	0.423	$band\_gap = \frac{5.61}{index\_of\_refraction}$
3	0.534	$band\_gap = elements_h - formation\_energy\_per\_atom$
2	0.642	$band\_gap = -formation\_energy\_per\_atom$
1	1.000	$band\_gap = elements_h$

Plot Type: Observed vs. Predicted Plot

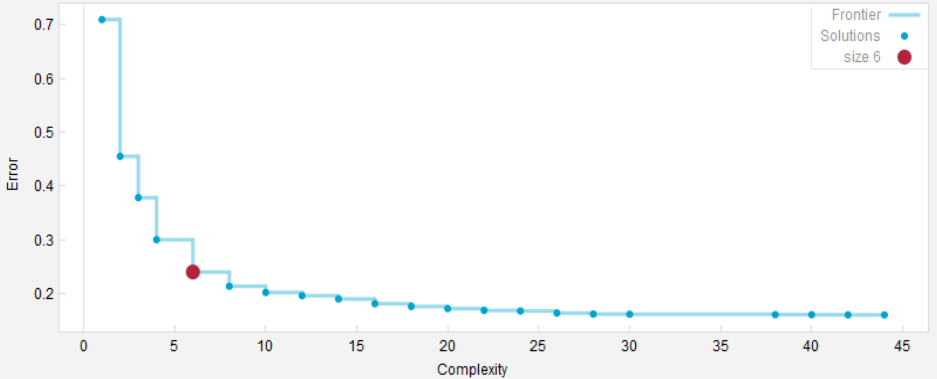


X Axis:

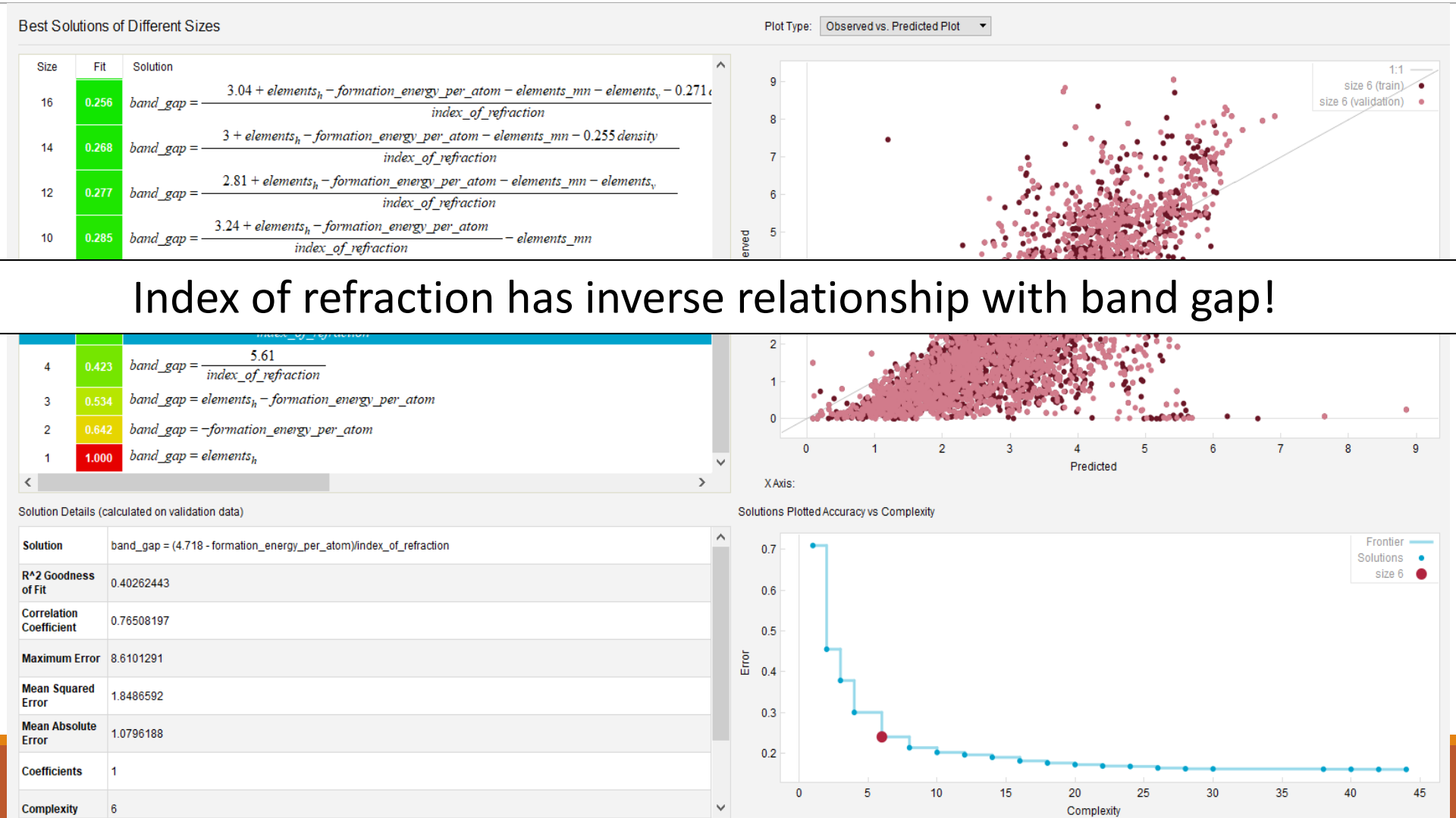
Solution Details (calculated on validation data)

Solution	band_gap = (4.718 - formation_energy_per_atom)/index_of_refraction
R^2 Goodness of Fit	0.40262443
Correlation Coefficient	0.76508197
Maximum Error	8.6101291
Mean Squared Error	1.8486592
Mean Absolute Error	1.0796188
Coefficients	1
Complexity	6

Solutions Plotted Accuracy vs Complexity



Dataset with dielectric properties



Index of refraction has inverse relationship with band gap!

Takeaways

1. To make wireless charging realize its potential, a resilient material that works with it is a must.
2. Metals in general are resilient, but reflect the charging waves.
3. Glass works, but is brittle.
4. Screening materials database will pre-screen materials for prototyping.
5. Mechanical properties do not correlate to band gap
6. The existence of oxygen and hydrogen indicates band gap
7. Density and index of refraction are inversely proportional to band gap.