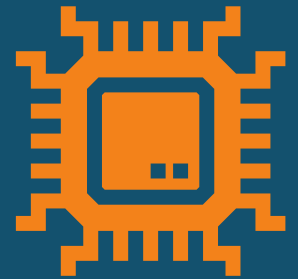# Better than traditional methods
## AI for formulation optimization in photolithography

The Customer

Our customer is a manufacturer of formulations used in semiconductor photolithography. As silicon chips get smaller and smaller, their products need to be more and more performant.

The Problem

Semiconductor companies are constantly innovating, pushing the boundaries of science to create smaller, faster chips. To do that they need to optimize their processes, and photolithography, where a formulation is applied to a silicon wafer and then selectively removed, using UV light, leaving a pattern, is one such process. The pattern laid down needs to be well defined and that depends on both the photosensitive molecules, composition of the formulation and the way it is laid down. In order to win business the company needed to develop a formulation that met very challenging specifications, that had never previously been hit.

The Process

Our customer had created and tested 100 formulations prior to starting the project with Citrine, and decided to run 200 experiments via traditional methods and 200 using Citrine to suggest experimental candidates (this is a great way to validate the use of AI). As well as the 100 starting datapoints, the Citrine Platform was able to provide additional chemical data on each molecule in each formulation automatically. A process of sequential learning (SL) (where experiments are carried out in batches and the results of each batch are used to retrain the AI model which then suggests the next batch) was used. The team monitored what the AI model was finding important to make predictions in each round of SL, via the platform's "Feature Importance Table", as way to see if it was in fact learning over time.
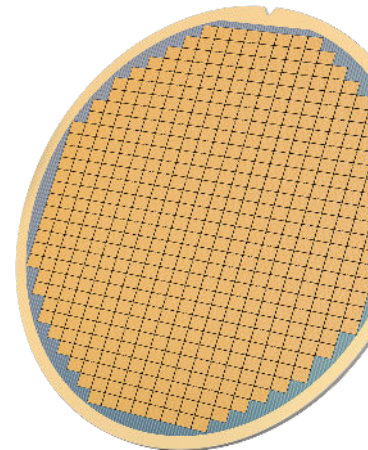
The Outcome

The traditional experimental method did not reach all target properties simultaneously. The Citrine Platform suggested previously unexplored areas of research, learned from the results and hit the targets.

- ☑ The Citrine Platform suggested candidate materials that broke through the existing pareto front and **hit all targets.** In fact, **the top 9 outcomes** (out of the 400 performed), were all generated by the Citrine Platform.

- ☑ The customer sees this break through as a way to continue to **innovate and remain competitive.**

- ☑ The next step is to incorporate use of the Citrine Platform into day-to-day workflows, so that the R&D team can **quickly respond to customer** requests with a formulation that can be refined in partnership with the customer.