This electronic supporting information S4 contains the main steps for fitting a response surface model using Minitab 17 (Minitab Inc.).

This process was used in “Predicting instrumental mass fractionation (IMF) of stable isotope SIMS analyses by response surface methodology (RSM)” by Fàbrega, C., Parcerisa, D., Rossell, J.M., Gurenko, A. & Franke, C.

1. Copy and paste the SIMS data and IMF calculations from your spreadsheet to Minitab 17.

2. Go to Stat, DOE (Design of Experiments), Create a Response Surface Design.
3. If desired, a Response Surface Design toolbar can be created in Tools.

4. Select Create Response Surface Design.

5. Introduce the number of continuous factors (predictor variables).

6. Look at the Available Designs proposed by Minitab.
7. Choose one of the proposed Designs.

8. Define the Factors.

9. Define the Options:
10. Define the Results.

11. Click OK - OK and Minitab will generate the specified Response Surface Design. The design appears in the Session Window, and the Matrix Design appears in the newly created Worksheet 2.
12. Go back to the *Worksheet 1* (SIMS data). Select *Define Custom Response Surface Design*.

![Worksheet 1 screenshot](image1)

13. With double click, select the *Continuous Factors* (predictor variables) from the left.

![Continuous Factors selection](image2)

14. Define the *Low* and *High Values* for the *Factors*.

![Define Custom Response Surface Design](image3)
15. Go to Analyze Response Surface Design:

![Image of Analyze Response Surface Design window]

16. Introduce the Response. In this case IMF.

![Image of selecting IMF as response]

17. Select the initial model Terms.

![Image of selecting terms]

18. If desired, in Options you can weight and transform the variables.
19. If desired, in Stewise you can select an automatic stepwise selection method of the model terms (we recommend None).
20. In Graphs, it is recommended to select Standardized residuals and Four in one:

![Graph selection](image)

21. In Results, choose the results you want to visualize.

![Results selection](image)

22. In Storage, choose (recommended) Fits, Residuals, Standardized Residuals, Leverage and Cook’s distance. The values will be stored in the Worksheet 1 in the final columns of the right. Click OK - OK and Minitab will create the starting Response Surface Model.

![Storage selection](image)
23. Check the Residual Plots:

![Residual Plots for IMF](image)

24. Check the Leverage (HI) and Cook’s distance (COOK) of the model points looking for high influential observations.

![Residuals table](image)

25. In the Session Window, Minitab shows the statistics of the model. Check the Model Summary, which contains the statistics S, R-sq (R²), R-sq adj. (adjusted R²) and R-sq pred. (prediction R²). From the Analysis of Variance, decide the first term that shouldn’t stay in the model, using as elimination criteria the p-value, the VIF or your background knowledge. In this example, the first term eliminated from the model will be X*Chamber Pressure, because it displays the highest p-value (0.895) of all the terms.
26. Go back to Terms (Ctrl+E) and move the term decided in Step 25 (X*Chamber Pressure in the example) from the list of Selected Terms to the list of Available Terms.

27. Click OK-OK and run the model again. Repeat the backward selection process of steps 23-24-25-26 until a satisfactory model is reached. Most of the terms remaining in the final model should be significant for the regression (p-values≤0.05) and present low multicollinearity (VIF≤10). The single terms of a hierarchical model can be no significant (p-value≥0.05).
28. Check the Leverage and Cook’s distance of the model points to ensure that the final fitted model does not contain highly influential points.

29. Go to Predict.

![Predict](image)

30. Enter the columns of values for prediction. The predicted values will be stored in the final columns of the right:

![Predict](image)
31. Generate the scatterplot of the predicted vs. the actual IMF values. The points should follow a 1:1 slope.
32. If desired, you can generate 3D surfaces or contour plots to visualize the behavior of the response respect to different pairs of predictor variables.
The 3D surfaces can be rotated with the 3D Graph Tools toolbar.

33. A double click on each part of the graph (surface, axis, title...) opens the respective edition window.