Wittig reaction in a continuous flow microreactor

Analysis method setup

The methods below describe the analysis methods as used by *Future*Chemistry and act as a starting point or reference when setting up an analysis method on location.

GC method

GC analysis was performed on a Shimadzu GC 2010 GC-FID equipped with a Quadrex 007 1701 column (length: 10 m, internal diameter: 0.1 mm, film thickness: 0.1 mm).

Table 1: GC program

Parameter	*Value*	*Parameter*	*Value*
Temperature program		**Split temperature**	250°C
0.0 – 0.5 min	60°C	**Injection volume**	1.0 µL
0.5 – 2.2 min	100°C/min	**Split**	200
2.2 – 2.7 min	230°C		

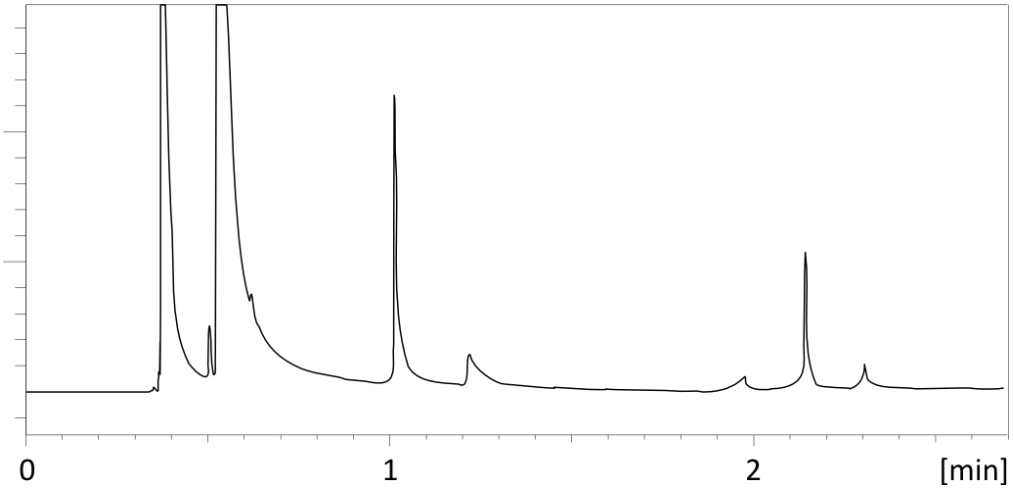

Figure 4: Example GC chromatogram

Table 2: Retention times of internal standard and products

Compound	*Function*	*Retention time [min]*
Anisole	internal standard	1.02
Benzaldehyde	substrate	1.21
***tert*-Butyl cinnamate (Z-isomer)**	side-product	1.98
***tert*-Butyl cinnamate (E-isomer)**	product	2.14

Procedure:

- To set up a valid GC analysis method, first try to analyse a mixture of all components (i.e. a reaction mixture from your Basic Experiment) until all peaks are properly separated. A reference GC program is stated above, which acts as a starting point for your analysis method.

- With the aforementioned mixture, you should observe peaks in the following order: *solvent* (large peak), *anisole* (medium peak), *benzaldehyde* (small to medium peak), *Z-isomer* (very small peak; might be invisible), *E-isomer* (medium peak).
- How to solve?
    - If peaks overlap, decrease the temperature gradient (or use isocratic temperature).
    - If analysis takes too long, increase column starting temperature (and vice versa).

Calibration

To measure percentage conversion of the formed product, a calibration is set up of the benzaldehyde substrate against an internal standard as in Table 4, using the concentrations from Table 5.

Table 3: Internal standard/substrate combination

Substrate	***Internal standard***	***Product***
Benzaldehyde	Anisole	*tert*-Butyl cinnamate (E-isomer)

Table 4: Calibration samples

Sample	***Int.standard***	***Substrate***	***DCM***	***Corresponding conversion***
1	100 µmol	100 µmol	1.0 mL	0%
2	100 µmol	75 µmol	1.0 mL	25%
3	100 µmol	50 µmol	1.0 mL	50%
4	100 µmol	25 µmol	1.0 mL	75%

Procedure:

- Prepare stock solutions of the internal standard (anisole) and the substrate (benzaldehyde) in DCM. Use concentrations that can be diluted to the required sample concentrations using the pipettes available in your laboratory. (*The minimum amount you can accurately dispense from a pipette depends on the type and volume.*)
- Prepare four samples as in Table 4.
- Make sure you can analyse your samples with the GC analysis setup. If not, modify the analysis setup until valid chromatograms are obtained.
- From the obtained chromatograms, obtain peak areas.
- Set up a calibration method according to the literature.