

Supplementary Information

Non-invasive analysis in micro-reactors using Raman spectrometry with a specially designed probe

Sergey Mozharov,¹ Alison Nordon,¹ John M. Girkin,^{*2} and David Littlejohn^{*1}

¹ WestCHEM, Department of Pure and Applied Chemistry and CPACT, University of Strathclyde, 295 Cathedral Street, Glasgow, G1 1XL, UK.

² Department of Physics, University of Durham, South Road, Durham, DH1 3LE, UK.

* denotes authors to whom correspondence should be sent

David Littlejohn: email: d.littlejohn@strath.ac.uk fax: 0141 548 4212

John M. Girkin: email: j.m.girkin@durham.ac.uk fax: 0191 33 45823

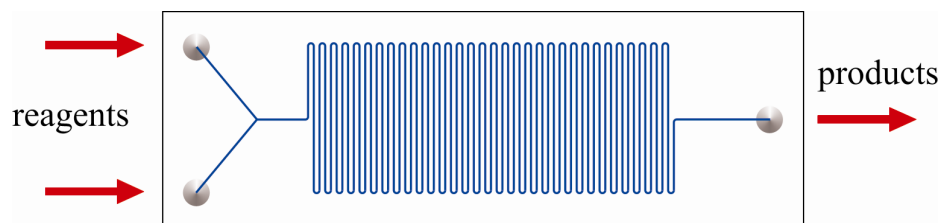


Figure S-1. Schematic of the micro-reactor.

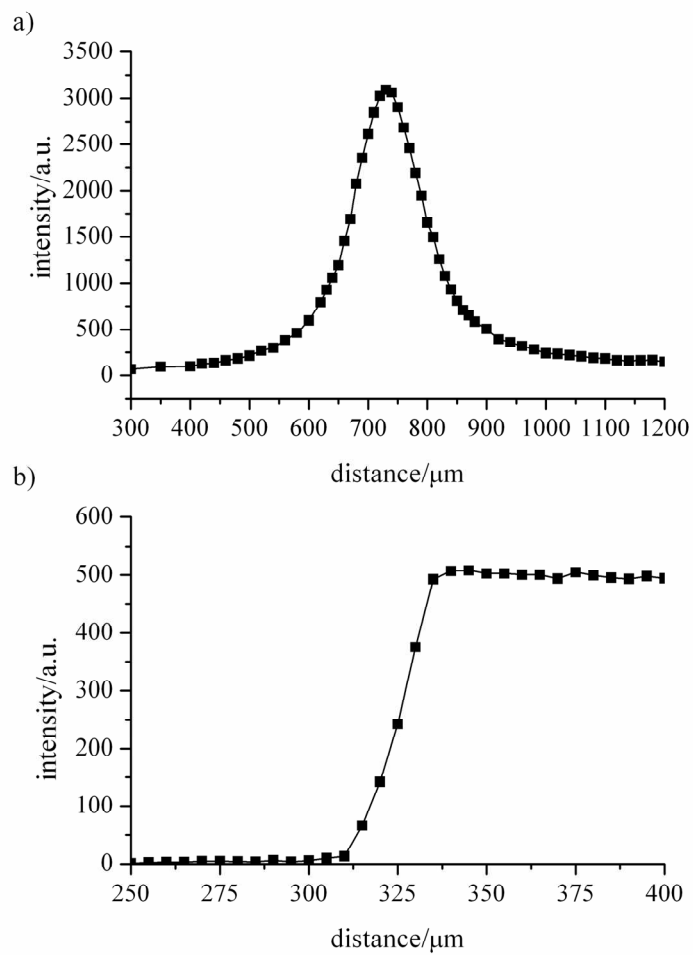


Figure S-2. a) Axial and b) transverse beam resolution measured at the glass-air interface by recording the intensity of the residual laser light. Spectral acquisition time, 0.5 s.

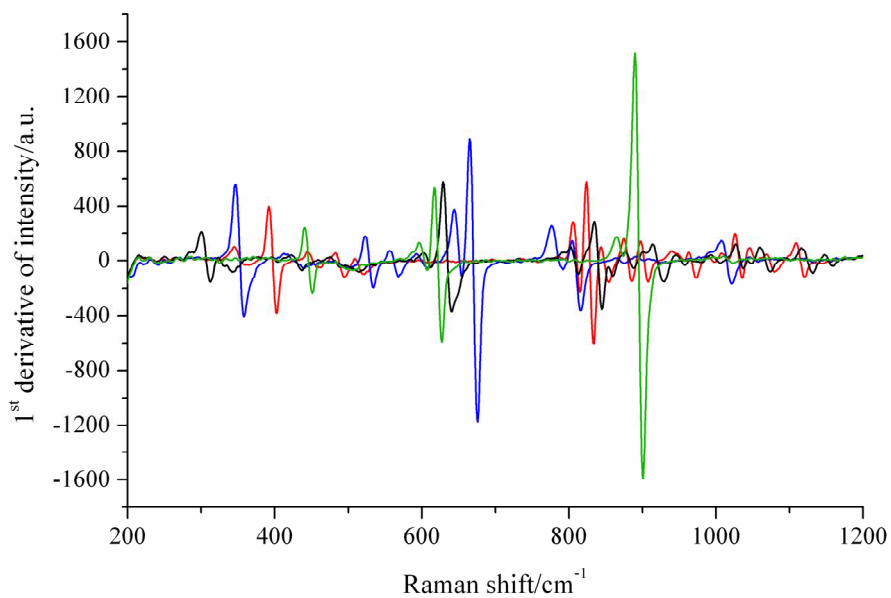


Figure S-3. First derivative Raman spectra of the pure reagents, butanol (red) and acetic anhydride (blue), and products, butyl acetate (black) and acetic acid (green), of the esterification reaction. Spectral acquisition time, 2 s.

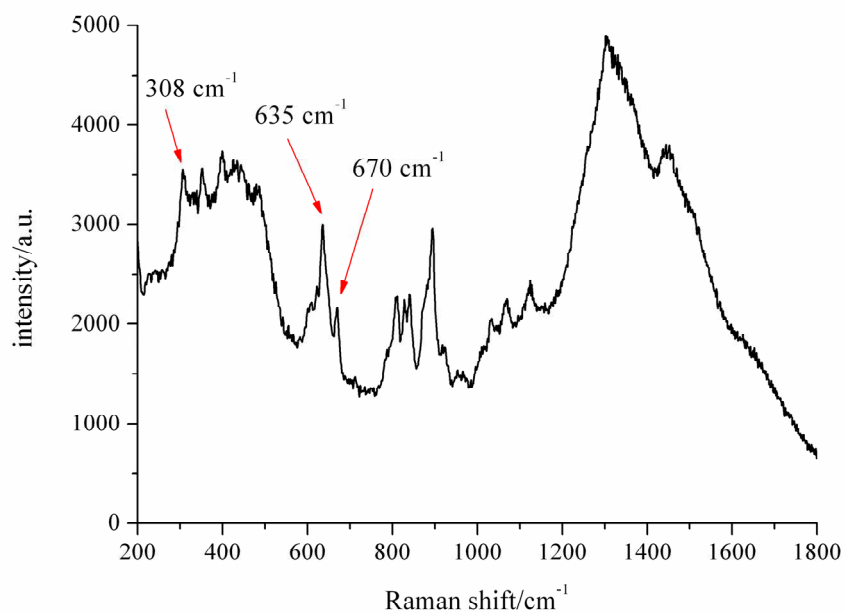


Figure S-4. Example Raman spectrum of the reaction mixture in the micro-reactor. The peaks at 308 and 635 cm⁻¹ arise from butyl acetate while that at 670 cm⁻¹ arises from acetic anhydride. The broad peak at about 1300 cm⁻¹ arises from the glass micro-reactor. Spectral acquisition time, 1 s.

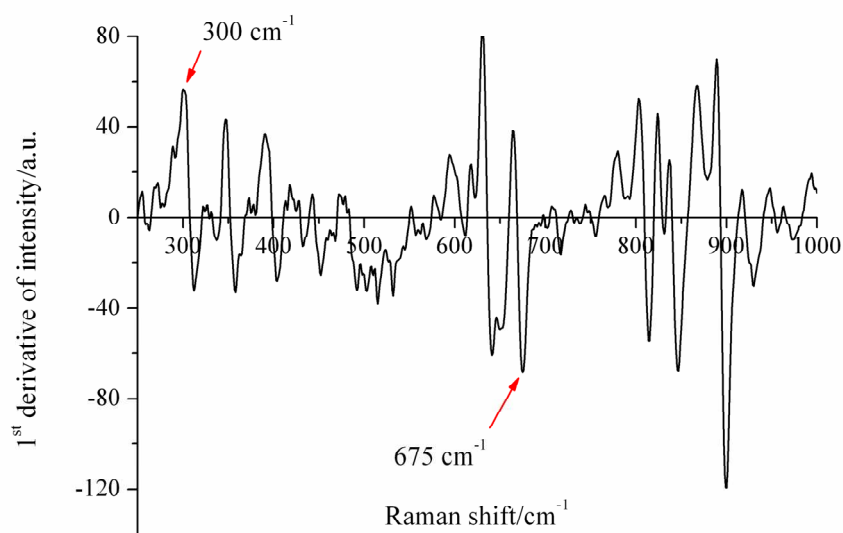
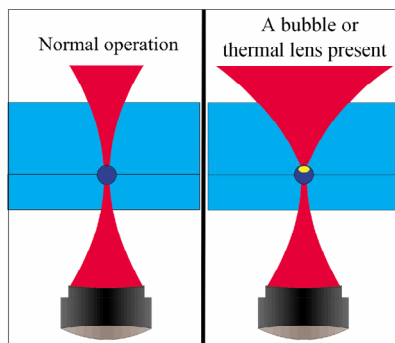


Figure S-5. Example 1st derivative Raman spectrum of the reaction mixture in the micro-reactor. The peaks at 300 and 675 cm⁻¹ arise from butyl acetate and acetic anhydride, respectively; the magnitude of these peaks can be used to monitor the progression of the esterification reaction. Spectral acquisition time, 1 s.

a)



b)

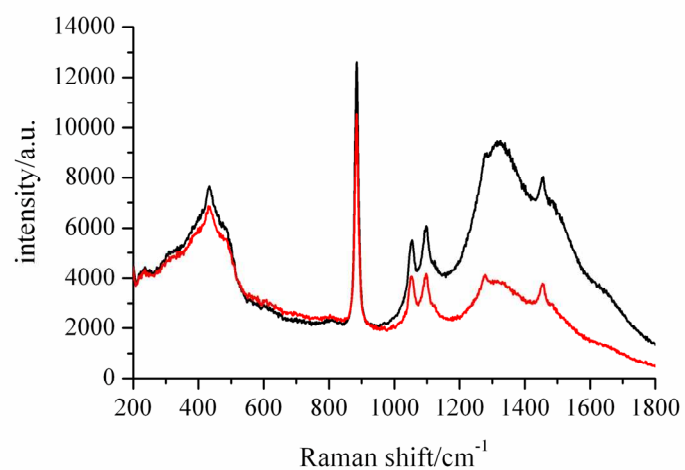


Figure S-6. a) Refraction of the laser beam by a bubble or thermal lens and b) ethanol spectra acquired under normal operation (black) and in the presence of a bubble or thermal lens (red).

Spectral acquisition time, 2 s.