

INTEGRATED IMPEDANCE SENSORS IN A MICROFLUIDIC SYSTEM: TOWARD A FULLY AUTOMATED HIGH THROUGHPUT NMR SPECTROSCOPY

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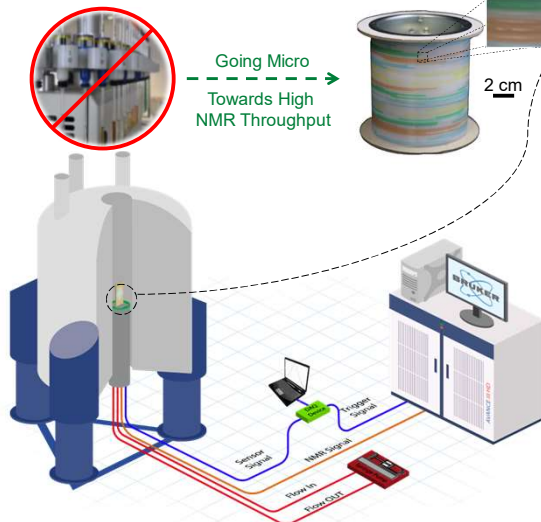
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Motivation

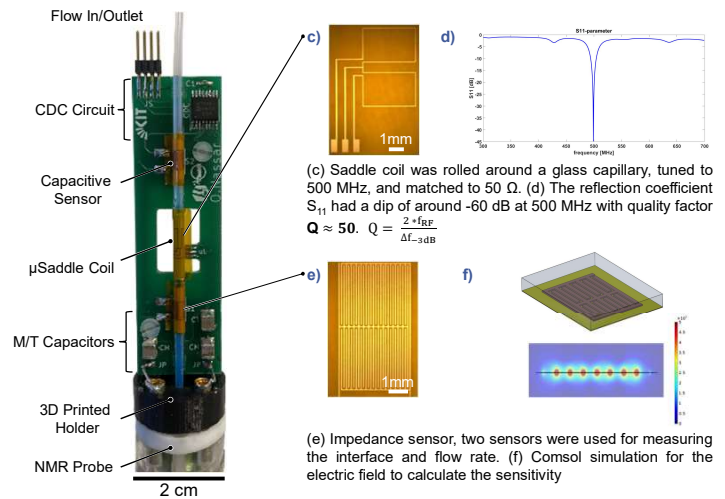
➤ Integrating microfluidic technologies with micro-NMR for high throughput spectroscopy with high sensitivity

➤ Towards NMR spectroscopy for metabolomics

a) System Overview



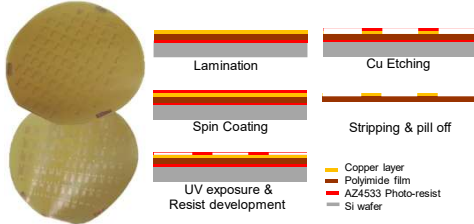
a) Customized Insert



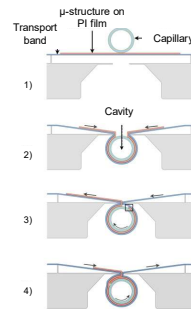
Batch Fabrication

Flexible polyimide substrate	25 μm
Copper thickness	9 μm
Glass Capillary (O.D./I.D.)	2/1.7 mm
Electrodes detection length	4 mm
Saddle coil detection region	4 mm

g) Fabrication process



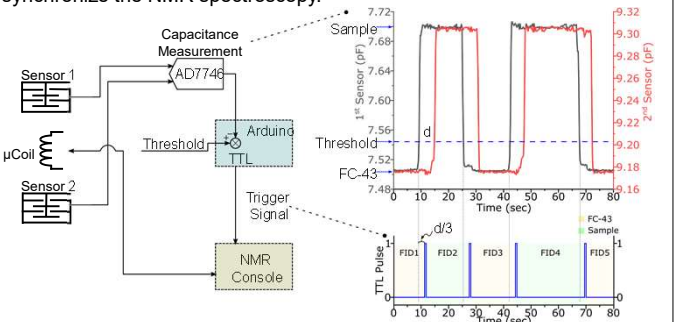
g) Rolling process



Instrumentation

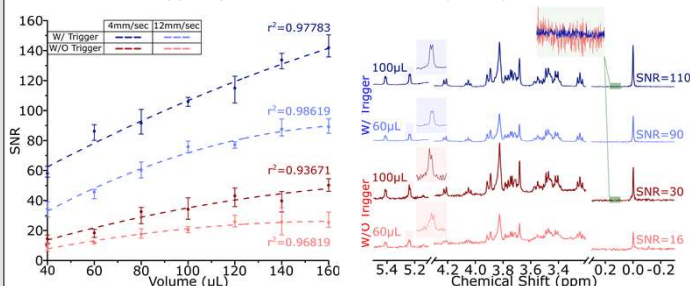
➤ Transmitting the impedance sensors value outside the magnet is done using a Capacitive to digital converter IC (AD7746).

➤ The sensors values are used by a microcontroller outside the magnet to synchronize the NMR spectroscopy.



Experiment 1:

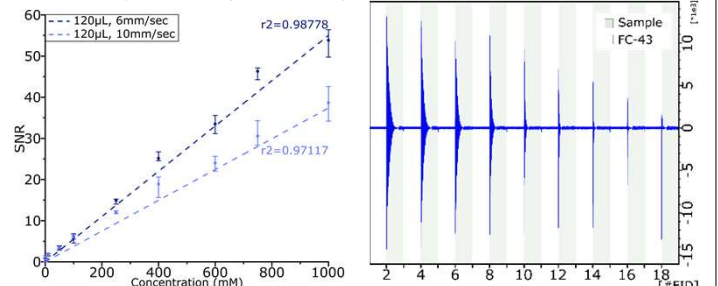
The tube is loaded with a single aqueous plug (300mM Glucose, 250mM Sucrose, and 30mM TSP), the sample volume and flow rate are varied. The experiment ran with and without triggering, and the SNR of the TSP (0 ppm) is compared.



❖ The SNR improved by a factor of 3.5 and 5 for volumes of 100μL and 60μL when implementing the automated triggered data acquisition

Experiment 2:

The tube is loaded with 9 individual samples (120μL) of different glucose concentrations (1 - 1000mM) separated by 80μL plugs of FC-43. The flow ran continuously until all plugs left the magnet.



❖ The triggering system robustly separated aqueous from oil signals.
❖ SNR scales linearly with concentration and can be improved by slowing the flow rate.