Preparing mono-dispersed liquid core PDMS microcapsules from thiol–ene–epoxy-tailored flow-focusing microfluidic devices

Piotr Mazurek (pioma@kt.dtu.dk), Anders Egede Daugaard, Søren Hvilsted and Anne Ladegaard Skov

Danish Polymer Center, Department of Chemical and Biochemical Engineering, Technical University of Denmark, Building 227, 2800 Kgs. Lyngby, Denmark

In this work we present a simple method for preparing a flow-focusing microfluidic device by applying thiol–ene click chemistry, which due to its great versatility and simple chemistry is being increasingly used for fabricating lab-on-chip devices.[1] This fascinating chemistry exhibits a great number of advantages, for example very high reaction efficiency, rapid reactions triggered by exposing compositions to UV-light, low exothermic effects and no byproducts.[2] One of the greatest advantages of these systems is good solvent resistivity, which allows for working with almost any type of material and thereby making thiol–ene systems excellent replacements for the currently most widely used PDMS microfluidic chips. We additionally extend a thiol-ene system by introducing a third compound to the composition making it a dual-cure system. Herein we modify a two-step crosslinking method presented by Saharil et al., which presents an efficient way for covalent bonding of the two microfluidic chip wafers through the introduction of an epoxy-containing compound working as a bonding agent.[3] With the help of this method we managed not only to avoid leakages but also preserved the possibility of surface modification of microfluidic chip channels.

An applied dual-cure system based on thiol–ene and thiol–epoxy "click chemistry" reactions was proved to be an extremely effective and easy to use tool for preparing microfluidic chips, thereby allowing for precise control over material properties and providing the possibility of covalently bonding chip wafers. Different thiol–ene–epoxy-based polymer compositions were tested with the help of DSC and ATR FTIR, in order to investigate their physical and chemical properties. Water contact angles were determined, thus verifying the high efficiency and selectivity of the chemical surface modification of compositions in relation to high hydrophilicity and hydrophobicity. An obtained microfluidic device was subsequently used in order to produce PDMS microcapsules of very narrow size distribution and which contained various common liquids, such as water and ethanol, as well as an ionic liquid, 2-hydroxyethylammonium formate.

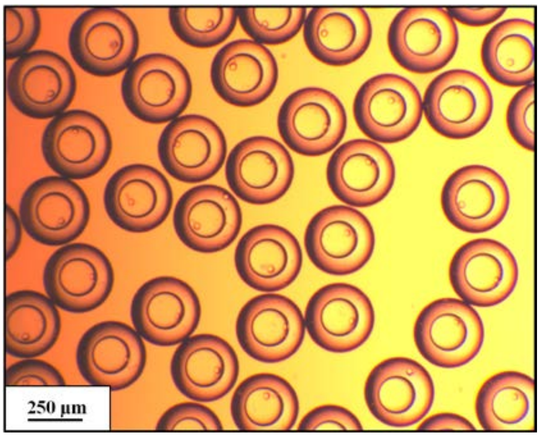

Figure 1. Optical microscopy image of a water-in PDMS-in water double emulsion.

References:

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