Fabrication of cellulose microstructures using a microfluidic channel

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Cellulose, the most abundant natural polymer in nature, is renewable, biodegradable, and biocompatible. Researchers are increasingly paying attention to this natural polymer for replacing petrochemically derived compounds in many areas (fibers, filters, membranes, etc.) due to an almost inexhaustible source of raw material. Cellulose, however, is difficult to process in solution, because of its intra- and intermolecular hydrogen bonds. Here, we report a single step approach for fabricating oil-drop embedded cellulose microstructures in a flow-focusing microchannel system. Production of the cellulose microstructures such as microfiber, micro-tube, and microcapsule, are based on the regeneration of cellulose from an ionic liquid by simply contacting with water in a microchannel. Mineral oil, cellulose solution in the ionic liquid, and aqueous glycerol solution were separately injected into the inner, middle, and outer channels. The cellulose was regenerated due to diffusion at the interface between the ionic liquid and water. The shape and size of mineral oil-droplet and the morphology of cellulose microstructures were controlled by the flow rates of the three solutions.