Table 1 experimental material.

|  |  |  |
| --- | --- | --- |
| Name | Standard | Source |
| sodium alginate | Analytically pure | SIGMA |
| SDS | Analytically pure | Solarbio |
| Twain 20 | Analytically pure | Damao Chemical Reagent Factory, China |
| Air  | - | Tsinghua University, China |
| Deionized water | - | Tsinghua University, China |
| Anhydrous ethanol | Analytically pure | Hengxing Chemical Reagent Manufacturing Co., Ltd, China |

Table 2 The main experimental equipment of study.

|  |  |  |
| --- | --- | --- |
| Name | Model | Company |
| Microfluidic chip | $$22.2×15.0×4.0 mm$$ | Tsinghua University |
| Micro feed pump | LSP01-2A | Lange Constant Flow Pump Co., Ltd, China |
| Electronic balance | AR224CN | Aarhus Instrument Co., Ltd |
| A magnetic stirrer | DF-101S | Tsinghua University |
| Rotary viscometer | DV2TLVTJ0 | BROOKFIELD company |
| Surface tension meter | K100C | KRUSS company |
| optical microscope | XSZ-490XC | Shangguang New Optical Technology Co., Ltd, China |
| High speed camera | FASTCAMSA4 | PHOTRON company |
| Syringe | 20 mL | Tsinghua University |

Table 3 Experimental case.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | $$Q\_{G}(\frac{μL}{min})$$ | $$Q\_{L}(\frac{μL}{min})$$ | $$μ/(mPa∙s)$$ | $$σ/(mN∙m^{-1})$$ |
| 1 | 20 | 50 | 2.41 | 24.6 |
| 2 | 30 | 50 | 2.41 | 24.6 |
| 3 | 40 | 50 | 2.41 | 24.6 |
| 4 | 50 | 50 | 2.41 | 24.6 |
| 5 | 60 | 50 | 2.41 | 24.6 |
| 6 | 50 | 30 | 2.41 | 24.6 |
| 7 | 50 | 40 | 2.41 | 24.6 |
| 8 | 50 | 60 | 2.41 | 24.6 |
| 9 | 50 | 70 | 2.41 | 24.6 |
| 10 | 50 | 50 | 2.41 | 32.1 |
| 11 | 50 | 50 | 2.41 | 32.1 |
| 12 | 50 | 50 | 2.41 | 32.1 |
| 13 | 50 | 50 | 1.6 | 33.6 |
| 14 | 50 | 50 | 2.41 | 33.6 |
| 15 | 50 | 50 | 2.41 | 34.5 |
| 16 | 50 | 50 | 3.1 | 34.5 |

Table 4 Generation features of different gas flow rate.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | $$Q\_{G}(μL/min)$$ | $L\_{G}(μm$) | T(ms) | f(s) |
| 1 | 30 | 444 | 14 | 70 |
| 2 | 40 | 491 | 7.5 | 135 |
| 3 | 50 | 534 | 5.8 | 172 |
| 4 | 60 | 610 | 4.9 | 200 |
| 5 | 70 | 660 | 4.6 | 220 |

Table 5 Generation features of different liquid flow rate.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | $$Q\_{G}(μL/min)$$ | $L\_{G}(μm$) | T(ms) | f(s) |
| 6 | 30 | 770 | 4 | 250 |
| 7 | 40 | 640 | 5.4 | 185 |
| 8 | 50 | 534 | 5.9 | 170 |
| 9 | 60 | 432 | 8.7 | 115 |
| 10 | 70 | 380 | 13.5 | 76 |

Table 6 Generation features of different liquid flow rate.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | $$σ(mNm^{-1})$$ | $L\_{G}(μm$) | T(ms) | f(s) |
| 3 | 24.5 | 533 | 5.9 | 170 |
| 10 | 31.6 | 566 | 5.9 | 173 |
| 11 | 33.0 | 574 | 6.7 | 153 |
| 12 | 34.1 | 600 | 6.3 | 160 |

Table 7 Generation features of different viscosity.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. | $$μ(mPa s)$$ | $L\_{G}(μm$) | T(ms) | f(s) |
| 13 | 1.60 | 500 | 3.6 | 280 |
| 14 | 2.42 | 440 | 4.3 | 240 |
| 15 | 2.50 | 415 | 4.5 | 230 |
| 16 | 3.01 | 399 | 4.81 | 209 |