Electronic Supplementary Material (ESI) for Nanoscale.

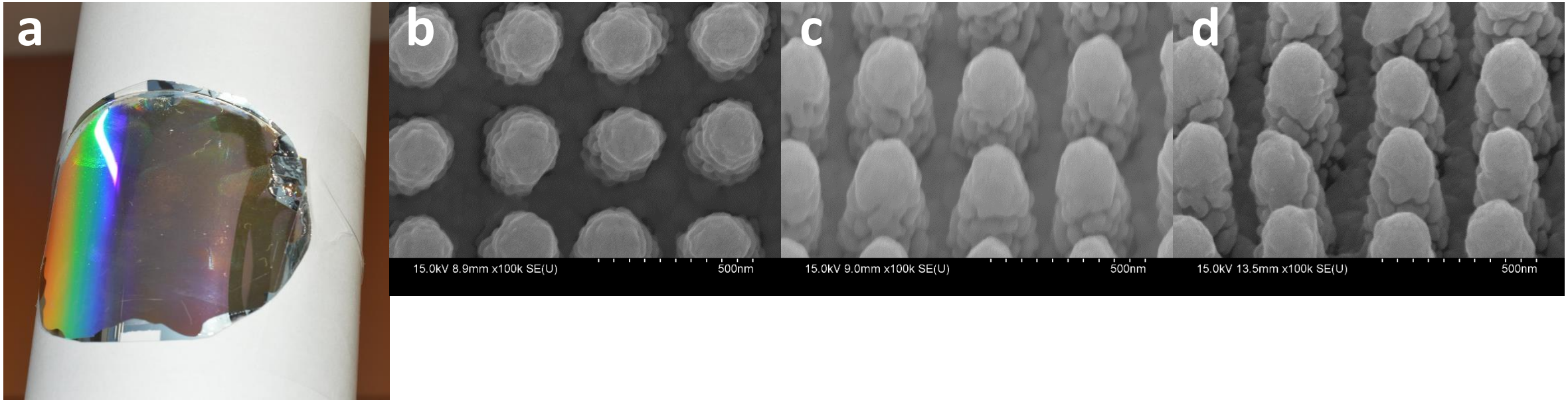


Fig. 1S. (a) A full-view photograph of one piece of FlexBrite with the diameter of 4 inches, wrapped around a mailing tube. (b) Top-view SEM of nanomushroom on FlexBrite. (c) 30^{o} tilted view of nanomushroom on FlexBrite. (d) 45^{o} tilted view of nanomushroom on FlexBrite.

Video S1. Color change of FlexBrite in a microfluid channel when the refractive index of fluid is gradually increased from n = 1 (water) to n = 1.47(100% glycerol) , starting from air.

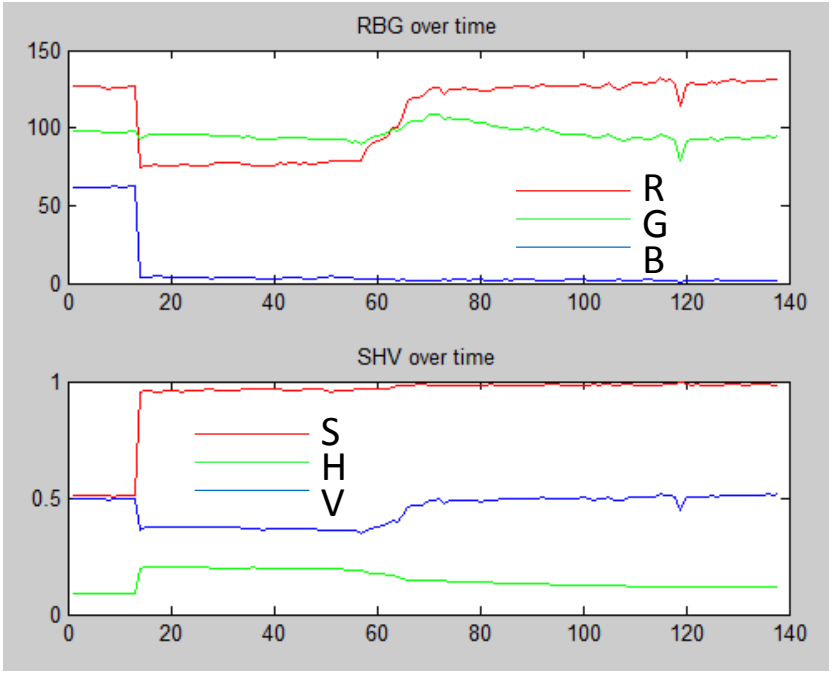
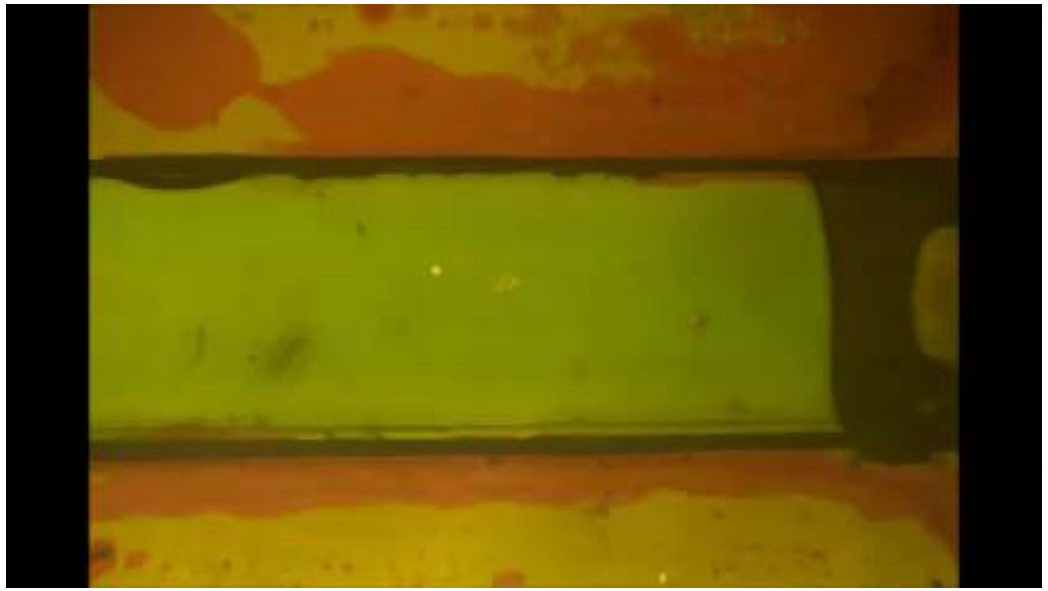


Fig. 2S. RGB (upper graph) and HSV (lower graph) values change of FlexBrite with time for the gradient increase of refractive index of fluid.



Video S2. Proof of reusability of FlexBrite. Observation of color change by alternatively replacing the fluid in microfluid channel with water and glycerol solution.

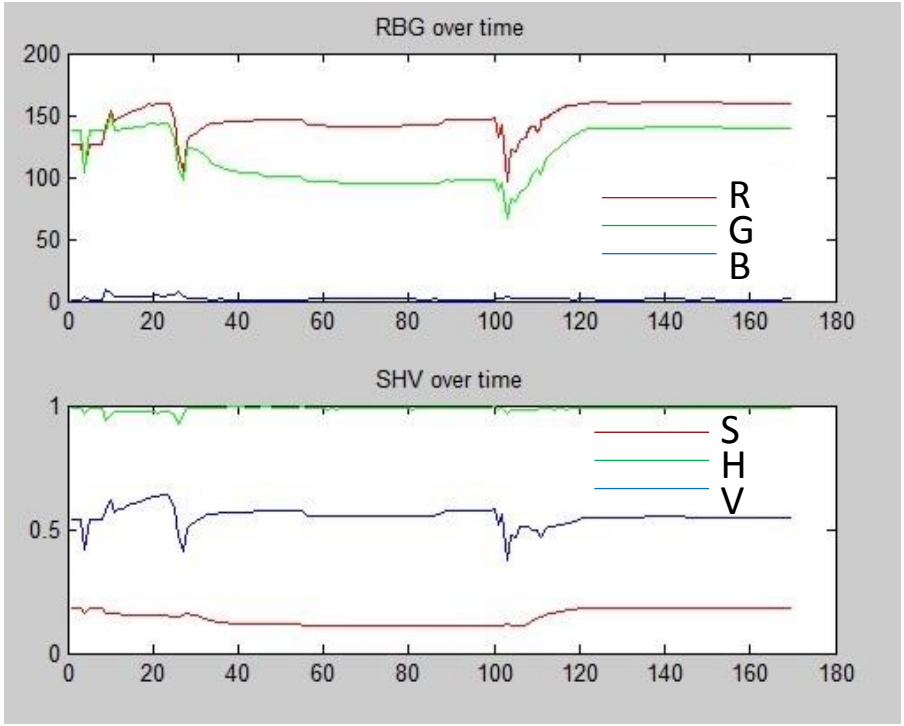


Fig. 3S. RGB (upper graph) and HSV (lower graph) values change of FlexBrite with time when alternatively replacing the liquid with water and glycerol.

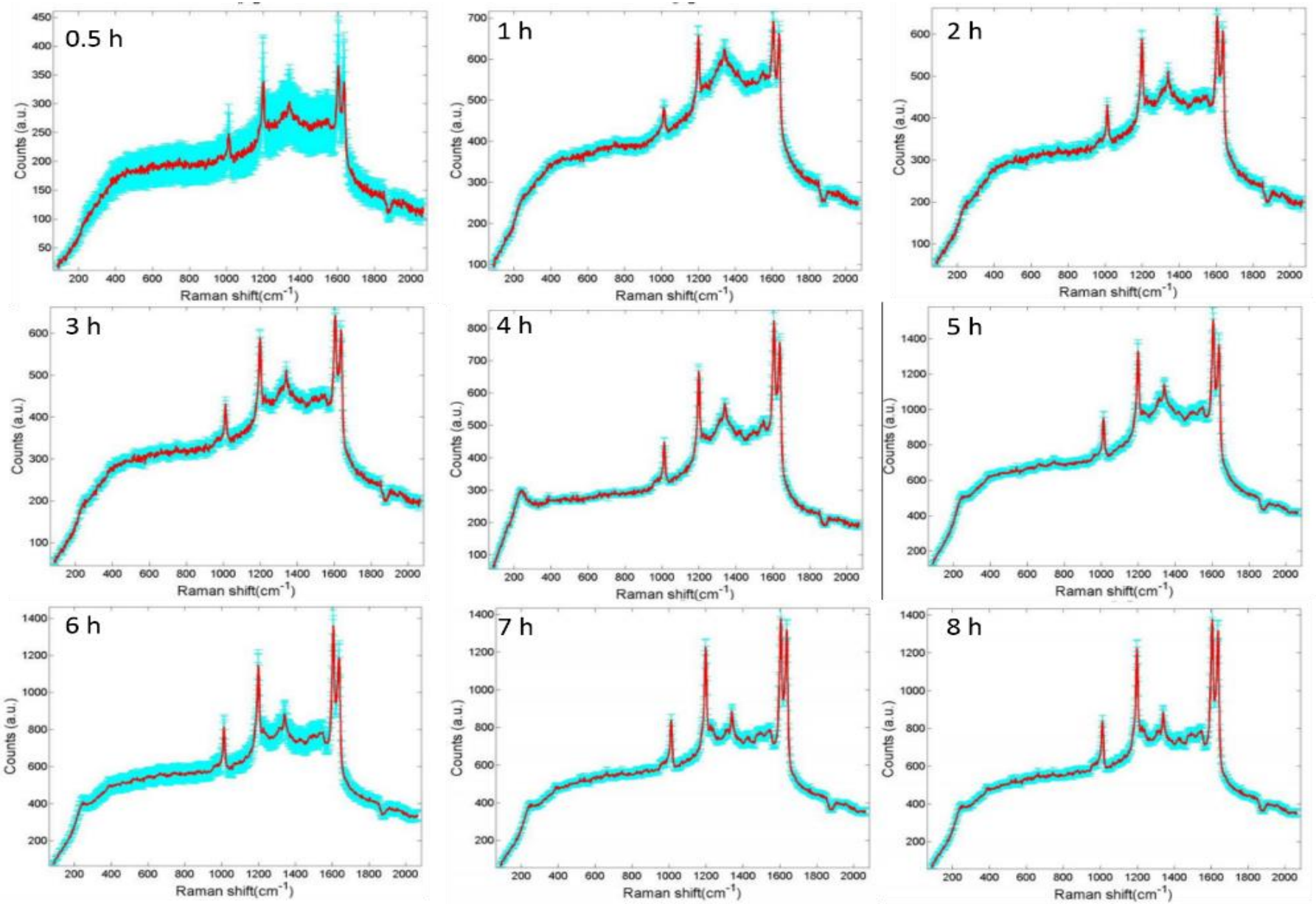


Fig. 4S. Kinetic study of BPE incubation time from 0.5 hour to 8 hours. After 5 hours' incubation the SERS signal become stable.

Video S3. Video to show the detection of methamphetamine in drinking water with B&Wtek NanoRam handheld spectrometer and FlexBrite.

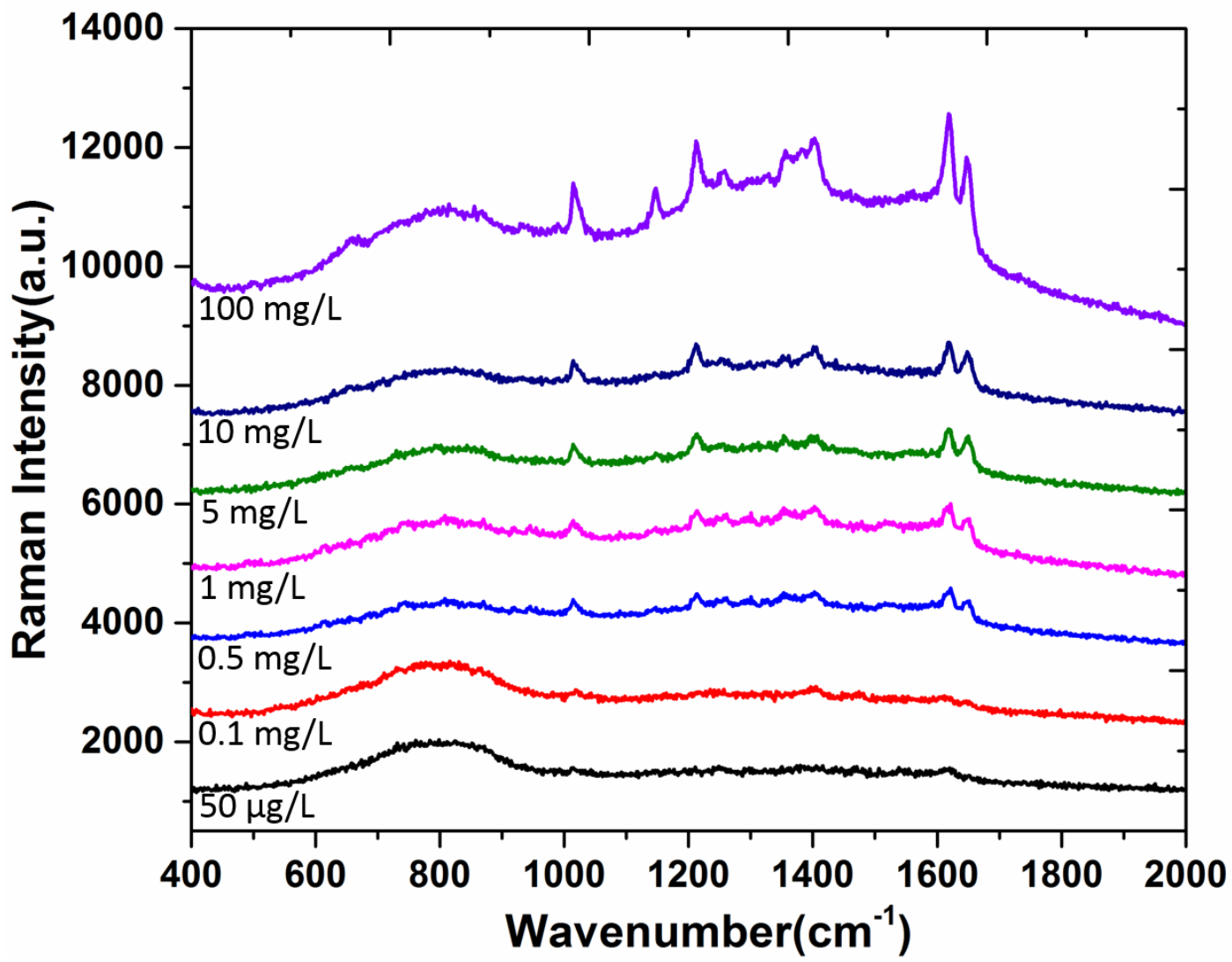


Fig. 5S . SERS of different dilutions of methamphetamine in aqueous solution. Limit of detection is 0.5 mg/L.

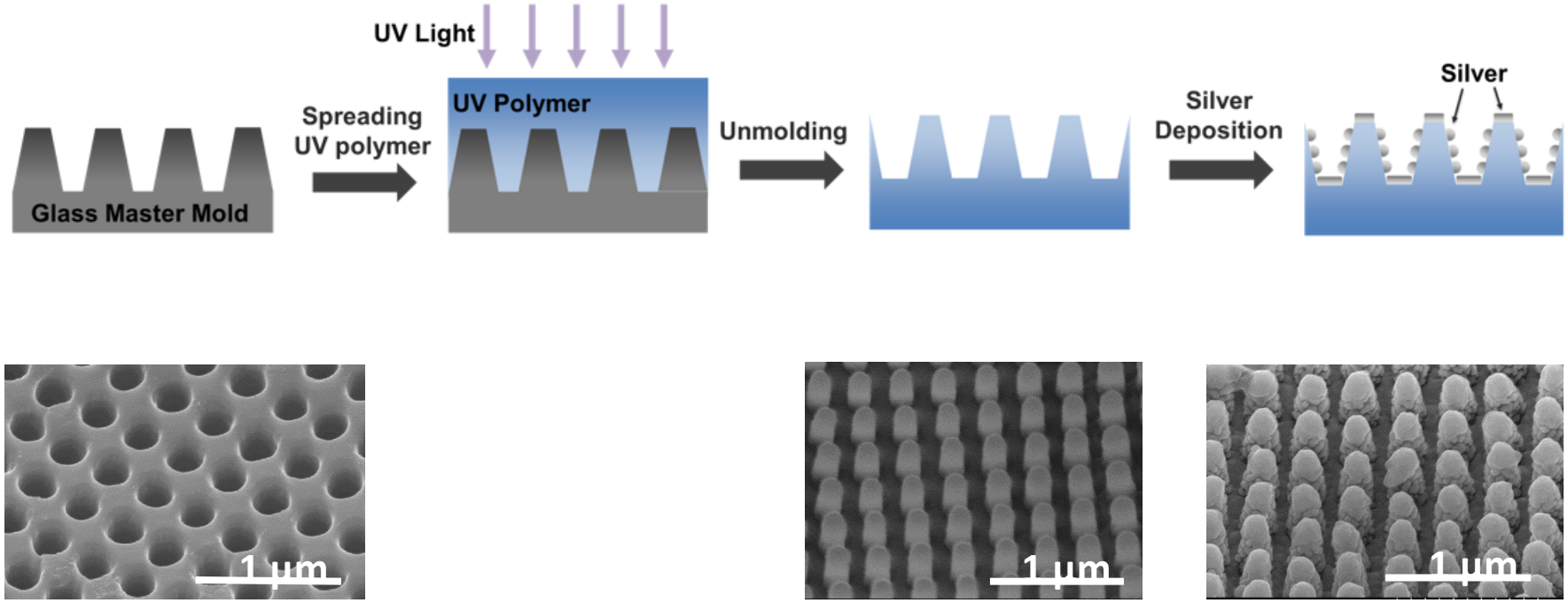


Fig. 6S. Fabrication process of FlexBrite. The glass master mold is made of silica. The nanohole array on silica was created by laser interference lithography followed by deep reactive ion etching. Firstly a 4 inch diameter (also performed with a 6 inch diameter) silicon dioxide wafer is coated with an average 0.45 µm thick photoresist and then exposed by 413 nm wavelength laser interference illumination with a dose of ~40 mJ cm^{-2}. After the photoresist development, the wafer is covered by a uniform array of nanoscale hollow photoresist mask of 150 nm in diameter and 350 nm in spacing distance. Secondly the wafer is subject to ion milling deep reactive ion etching by using a highly directional Bosch process. The unprotected circular area was etched down for 500 nm to form nanohole array. The last step is 90 nm Ag deposition after 9 nm Ti deposition as adhesion layer.

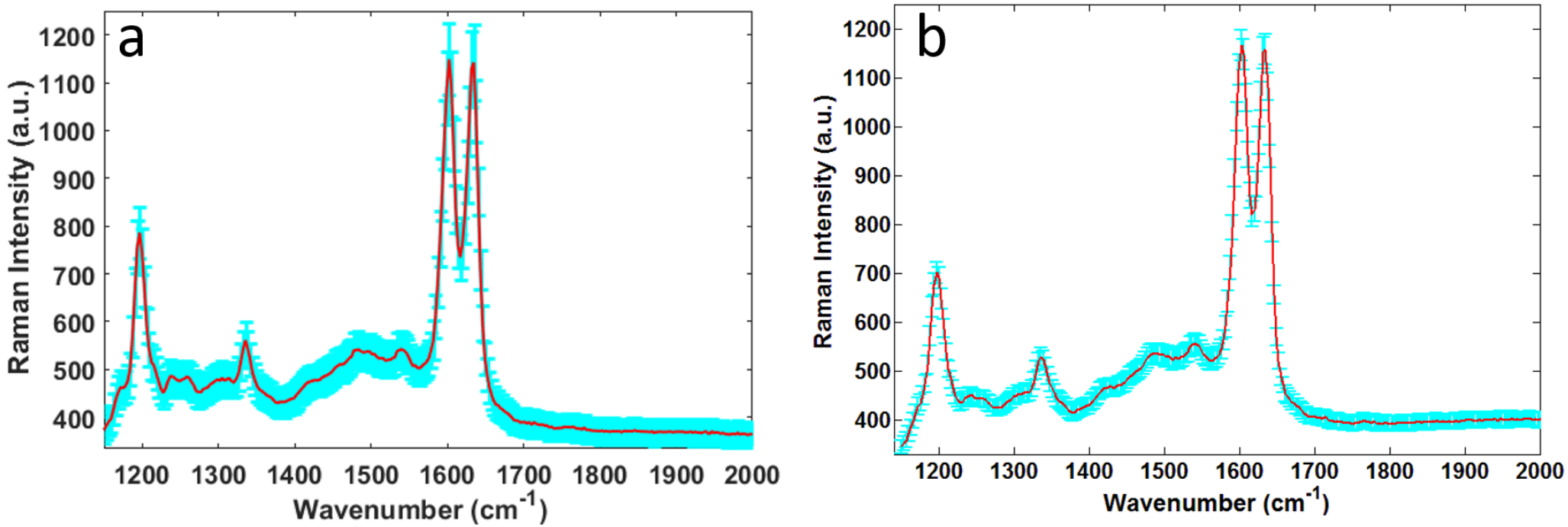


Fig. 7S. SERS comparison of FlexBrite before (a) and after (b) SiO_2 deposition for 5 seconds with BPE incubation for 5 hours.

Detail calculation of SERS enhancement factor (EF)

The average of SERS enhancement factor (EF) from FlexBrite sensor can be calculated as the following equation:

$$EF = \frac{I_{SERS}}{I_{Raman}} \times \frac{N_{Raman}}{N_{SERS}} \times \frac{P_{Raman}}{P_{SERS}} \times \frac{T_{Raman}}{T_{SERS}}$$

where I_{SERS} and I_{Raman} are integrated scattered intensities of Raman signal from FlexBrite sensor and BPE bulk solution. N_{SERS} and N_{Raman} are the number of molecules being probed on FlexBrite sensor and in the BPE bulk solution. P_{SERS} and P_{Raman} are the power intensity of excitation laser applied onto FlexBrite sensor and BPE bulk solution. T_{SERS} and T_{Raman} are the acquisition time when measuring Raman signal on the FlexBrite sensor and in the BPE bulk solution. I_{SERS} and I_{Raman} were measured with the integrated peak intensity at wavenumber 1607 cm^{-1}. The integrated Raman intensity of FlexBrite sensor and BPE bulk solution substrate were 235359.05 and 4585.83. For the calculation of probed molecule number, the surface area of top Ag layer, bottom Ag nanoparticle, and sidewall Ag nanoparticles need to be considered. We calculated the active Raman enhanced surface area as the total surface area of silver covered on the device. The model we applied here was the one used in FDTD simulation. The laser spot size and focal length after 20X objective lens were measured as 6.06 μm and 3 mm. The surface area of single BPE molecule is 30 $Å^2$.[S2] The concentration of BPE bulk solution was 100 mM. As a result, the N_{SERS} and N_{Raman} can be calculated as 1.59×10^8 and 5.22×10^{12}. The laser power intensities applied on FlexBrite sensor and BPE bulk solution were 211 μW and 1.23 mW. The acquisition time were 10 and 30 seconds for Raman measurements on FlexBrite sensor and BPE bulk solution. Finally, by applying all the parameters and EF equation above the SERS EF of FlexBrite sensor under solution-based environment can be estimated as 7.26×10^7.