Microwave dielectric heating of non-aqueous droplets in a microfluidic device for nanoparticles synthesis

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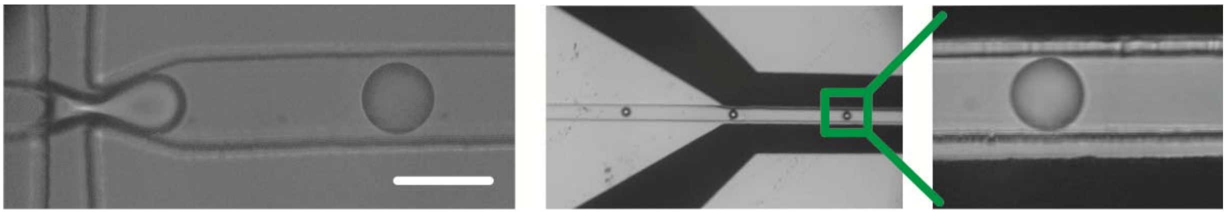


Figure SI 1 Images of the microfluidic device. From left: flow focusing droplet maker and images of the droplets entering microwave heater. Scale bar 50 μm.

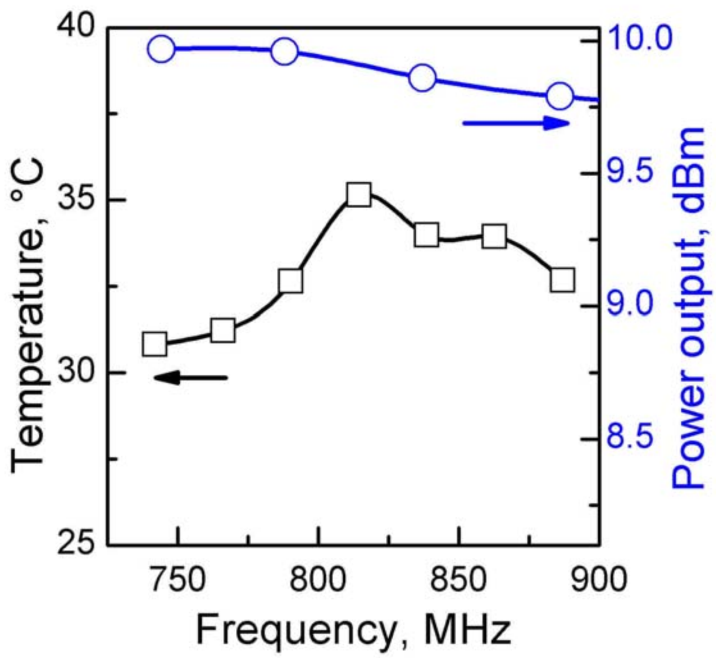


Figure SI 2 Correlation between the microwave frequency and the temperature of the benzyl alcohol droplets. The frequency power dependence of power output of the voltage-controlled oscillator was taken from data sheet of ZX95-1200W+, Mini-Circuits (blue circles). The temperature was measured with IR camera (black squares; see Material and Methods for details). The experiments are performed at a constant flow rate of benzyl alcohol of 20 μl/h and the oil at 120 μl/h, at peak-to-peak voltage of 8.85 V. Although the output power in the frequency range of 700-900 MHz changes no more than 3%, the temperature of the benzyl alcohol droplets changes of about 13%. This dependence correlates with the dependence of dissipation factor (tanδ) of benzyl alcohol on frequency.[1]

Table SI 1 Summary of dielectric properties of common solvents used for non-aqueous synthesis.

Solvent	τ [ps]	tanδ	f[MHz]	Ref.
benzyl alcohol	188	0.546 0.587	700 900	[1]
2-butanol	378.20	0.923 0.833	700 900	[2]
glycerol	1215.6	0.866 0.759	433.9 900	[3]
diethylene glycol	112.87	0.520	900	[3, 4]
hexanol	976	0.568 0.341	433.9 900	[3]

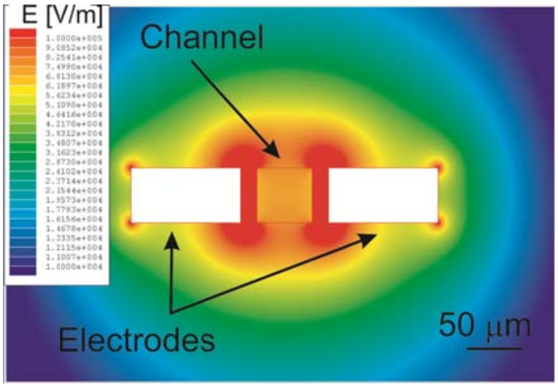


Figure SI 3 A quasi-static electric field simulation superimposed on a cross section of the microwave oven at 12 V peak-to-peak voltage.

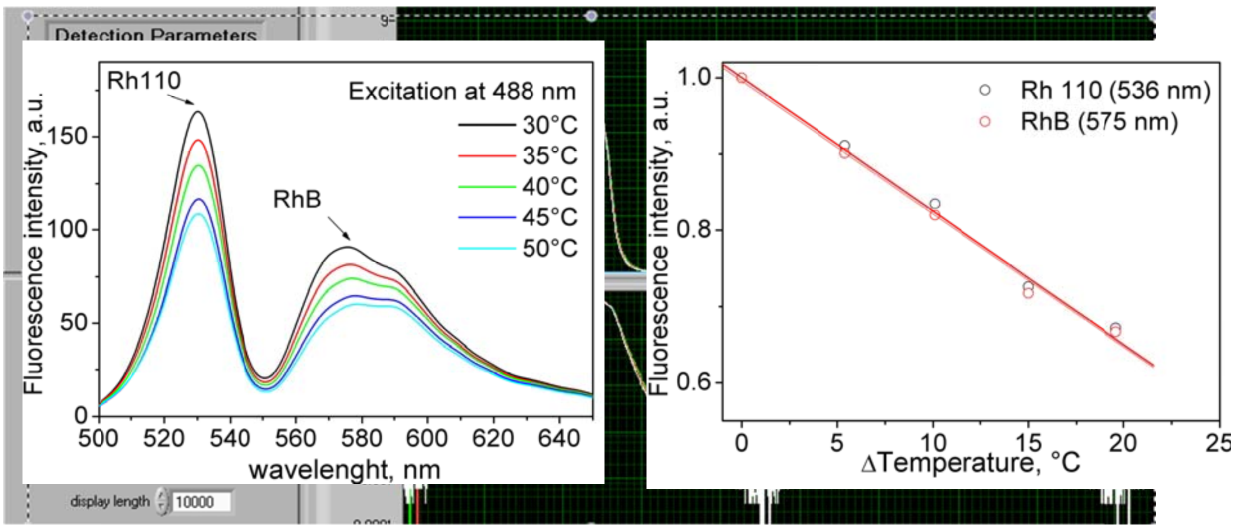


Figure SI 4 Wavelength scan fluorescence spectra of rhodamine B and rhodamine 110 dissolved in benzyl alcohol at varying

Figure SI 5 Temperature dependence of the fluorescence intensity of rhodamine B and rhodamine 110 in benzyl alcohol.

Figure SI 6 Image of the Labview interface used to record fluorescence intensity of up to three different dyes inside single droplets. In this case fluorescence emission of rhodamine B and rhodamine 110 are represented by red and green color respectively. The background fluorescence level detection is set to 1 V and the maximum to 10 V.

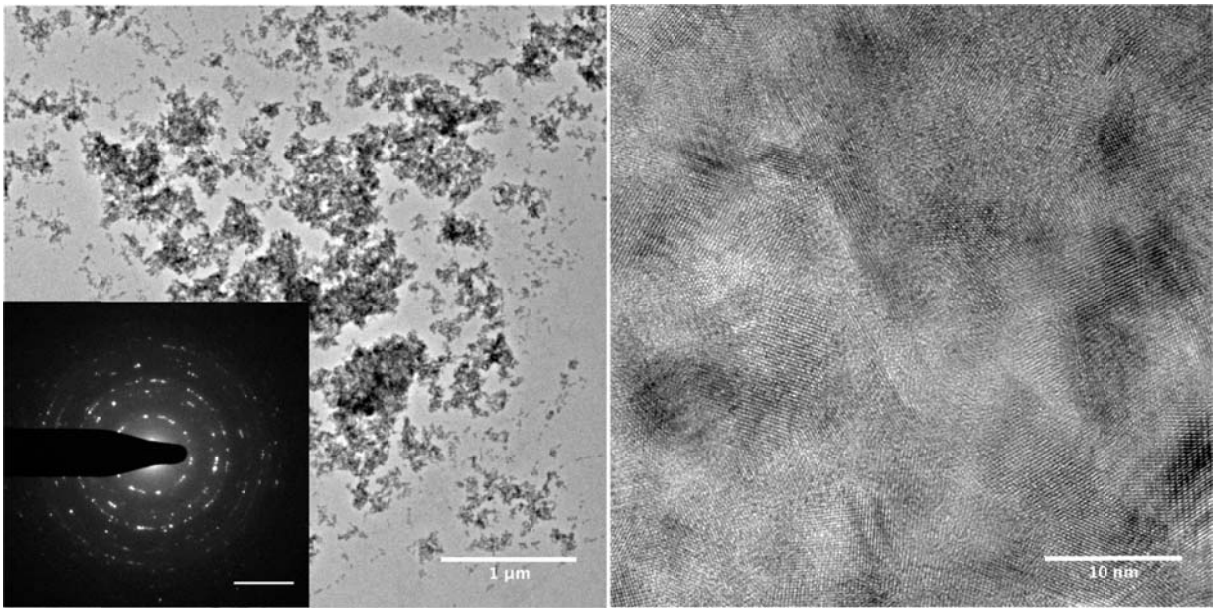


Figure SI 7 TEM, HR-TEM and SEAD (inset scale bar 1/5nm) of nanoparticles washed with ethanol.

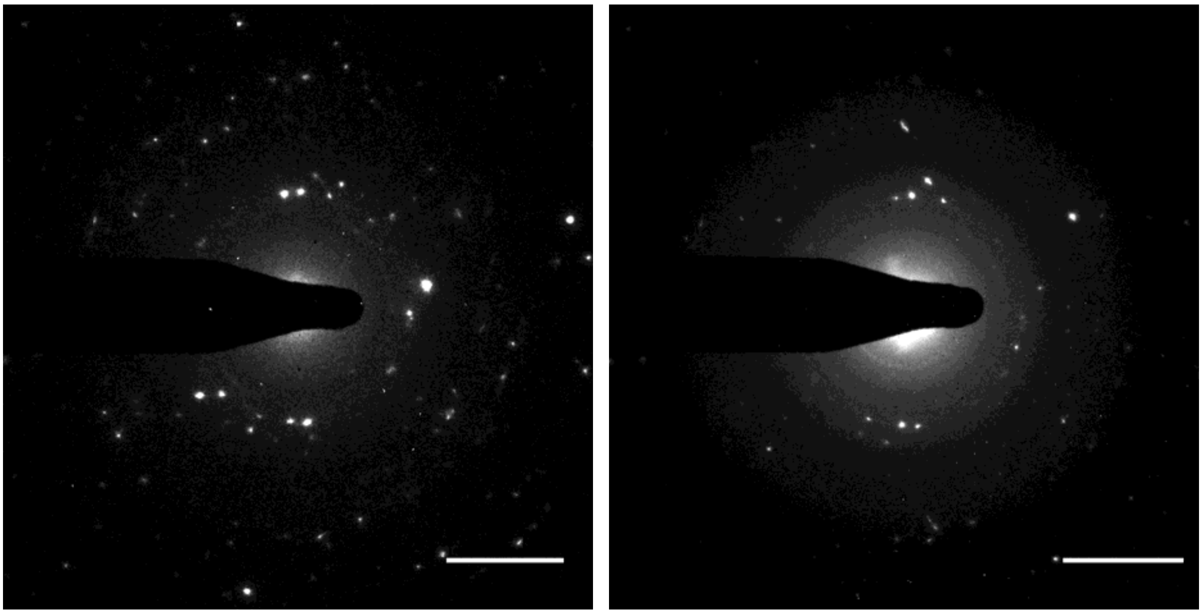
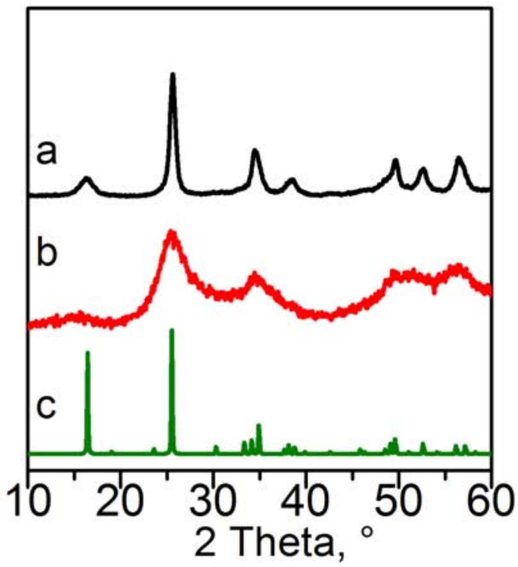


Figure SI 8 SEAD patterns recorded consecutively at the same spot (scale bar 5 1/ nm).



SI Figure 9 XRD patterns of reaction product synthesized in conventional laboratory microwave: (a) 120°C, (b) at 60°C, c. reference pattern of $WO_3 \cdot H_2O$, ICDD Nr. 00-018-1418.

References Supporting Information

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