

Supporting Information

Laser ablated vortex fluidic mediated synthesis of superparamagnetic magnetite nanoparticles in water under flow

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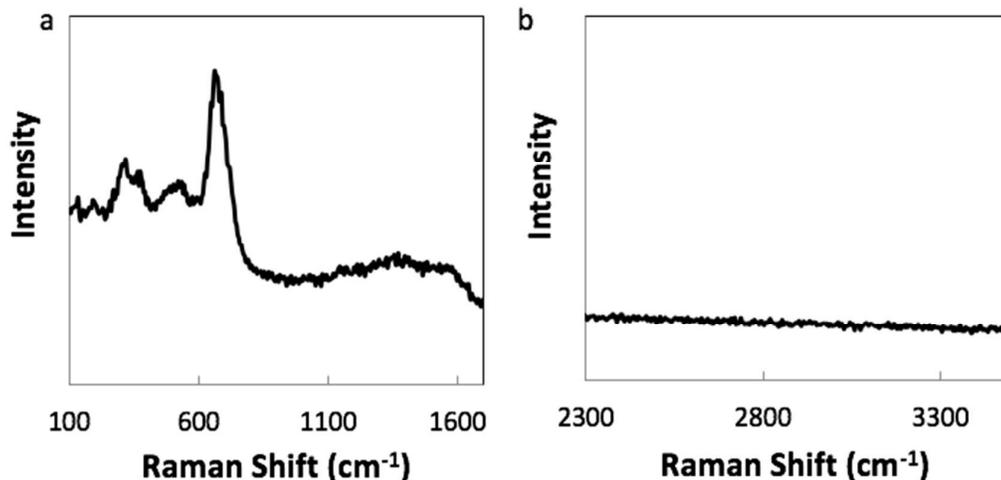


Figure S1: (a) First-order Raman spectrum for the as prepared IONPs using the VFD, and (b) second-order Raman spectrum for the as prepared IONPs using the VFD. IONPs were prepared at laser power 360 mJ for the VFD tube rotated at 7500 rpm for 15 min, in the confined mode with 1 mL water.

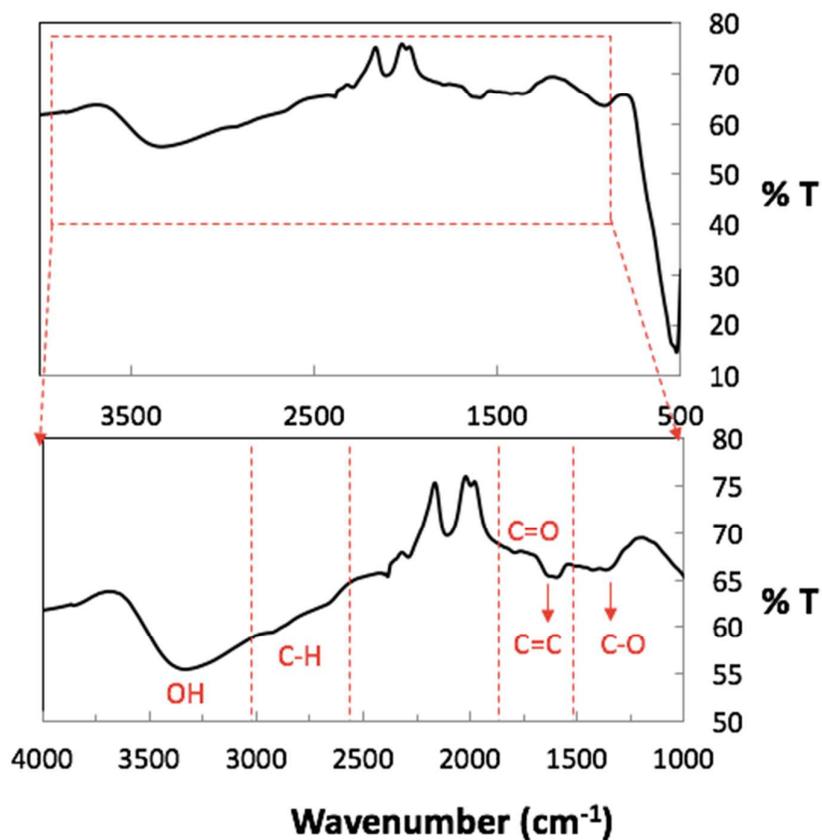


Figure S2: FT-IR spectra of the IONPs prepared at 360 mJ, 7500 rpm for 15 min with 1 mL of water. Assignment of the peaks are based on previous literatures^{1,2}.

Various vibration modes of carbon are present (Figure 4), C-O-C at 1230-1320 cm^{-1} , sp^2 -hybridized C=C at 1500-1600 cm^{-1} , COOH at 1650-1750 cm^{-1} , C=O at 1600-1650 cm^{-1} and 1750-1850 cm^{-1} and C-OH at 3050-3800 cm^{-1} .

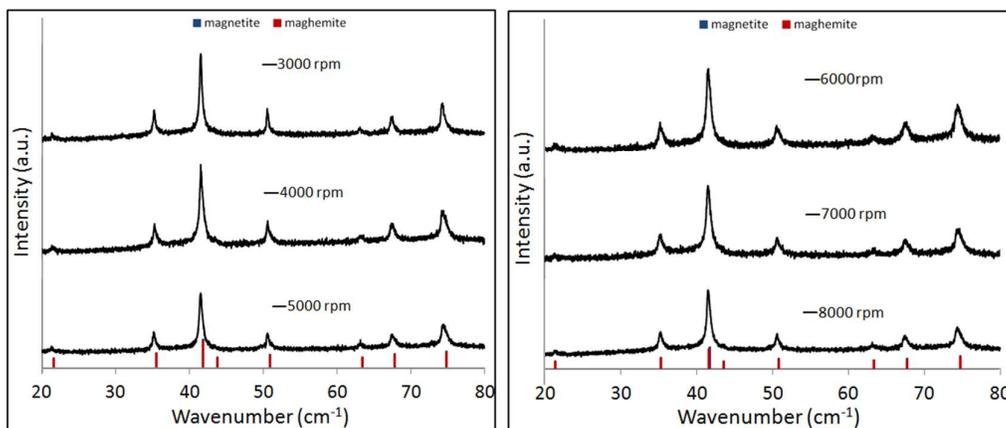


Figure S3. XRD of iron oxide nanoparticles (IONPs) obtained at different rotational speeds of VFD operating in the confined mode at 360 mJ containing 1 mL water for 15 min.

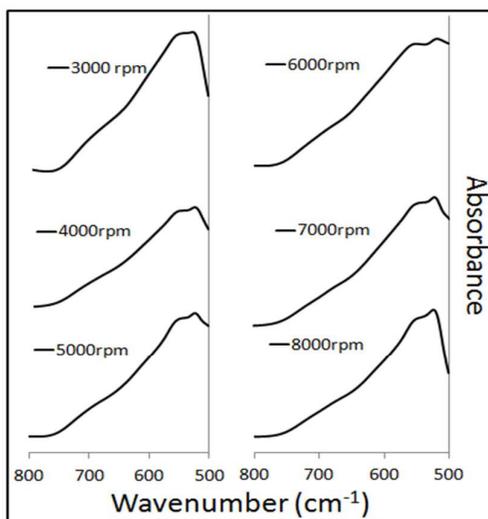


Figure S4. FT-IR spectrum of IONPs obtained at different rotational speeds of VFD operating in the confined mode at 360 mJ containing 1 mL water for 15 min.

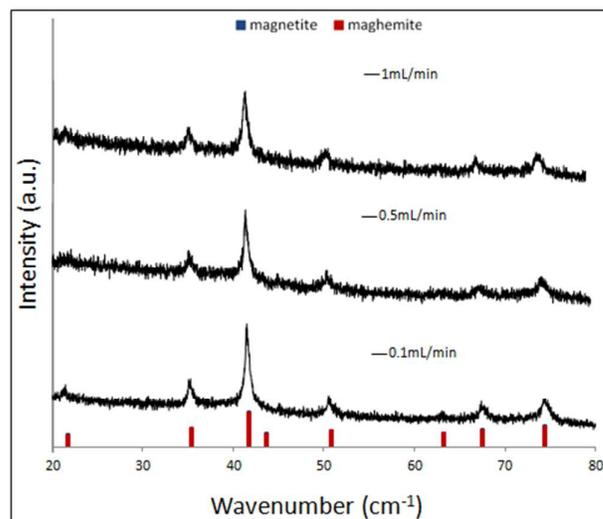


Figure S5. XRD of IONPs obtained at different flow rate of VFD (0.1, 0.5 and 1 mL/min) operating in the continuous flow mode at 360 mJ.



Figure S6. Samples left inside the VFD tube post VFD processing under continuous flow at 360 mJ, 7500 rpm with flow rate at 0.1 mL/min.

Table S1. Crystallite size of the IONPs estimated by XRD using Debye-Scherrer equation, $\Delta(2\theta) = 0.9\lambda/L\cos(\theta_0)$.

	360 mJ (in water)	360 mJ (in air)
Average particle size	14.22 nm	20.71 nm

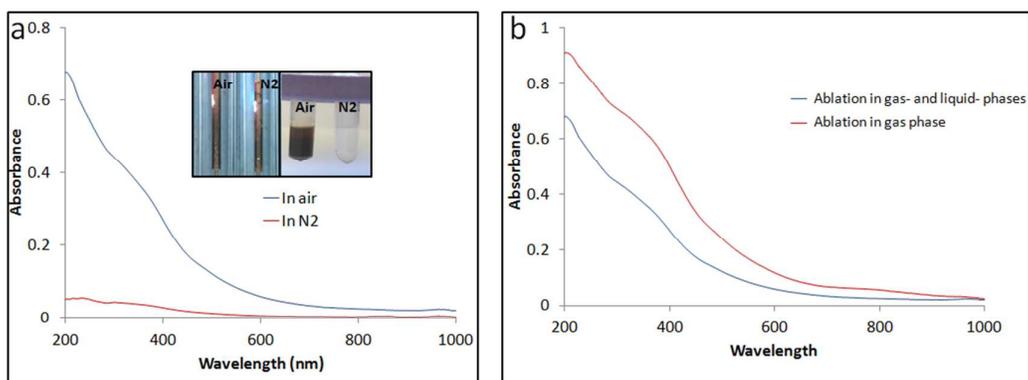


Figure S7. UV-vis of IONPs obtained using VFD (a) in the atmosphere of air or N₂; (b) under either gas-phase or gas- and liquid- phases. Operation of VFD in the confined mode at 7500 rpm for 15 min at laser power of 360 mJ.

References:

1. Sudhakar, S.; Jaiswal, K.; Peera, G.; Ramaswamy, A. P., Green Synthesis of N-graphene by Hydrothermal-microwave Irradiation for Alkaline Fuel Cell Application. *Int. J. Recent Sci. Res.* **2017**, *8*, 19049-19053.
2. Sudesh; Kumar, N.; Das, S.; Bernhard, C.; Varma, G. D., Effect of Graphene Oxide Doping on Superconducting Properties of Bulk MgB₂. *Supercond. Sci. Tech.* **2013**, *26*, 095008.