Electronic Supporting Information (ESI)

Synthesis and Electrochemical Characterization of Electroactive IoNanofluids with High Dielectric Constant from Hydrated Ferrous Sulphate

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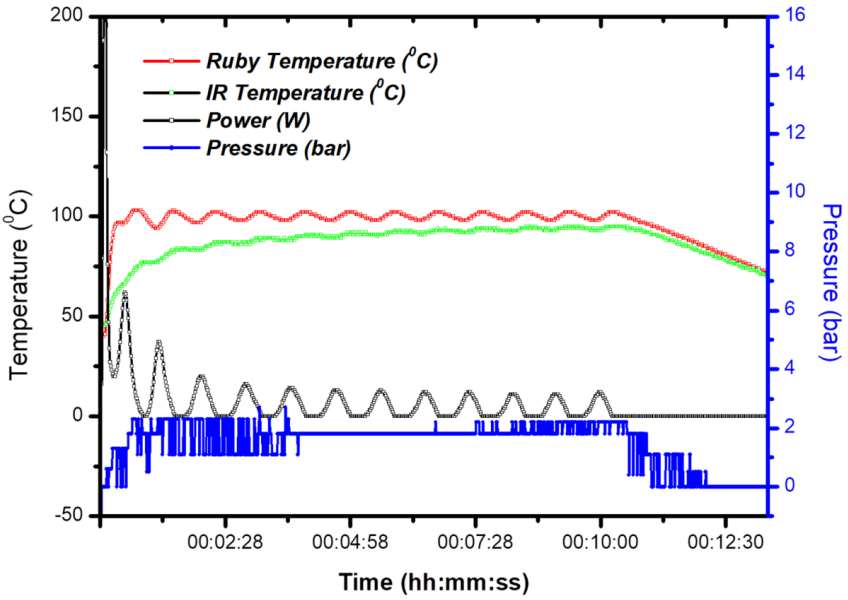

Figure S1. Microwave reaction profile of IoNanofluid obtained from Monowave 300 reactor.

Though the temperature of the reactor was set constant at 100˚C, the measured microwave (MW) reaction profile showed a continuous sinusoidal wave like pattern detected by the IR and Ruby thermometer due to the effect of microwaves on the dipolar ionic liquid (IL) molecules (in **Fig. S1**). This proofs that ionic conduction mechanism and dipole rotation that occurs simultaneously in the reaction medium converts the MW energy to heat energy. The ILs can absorb MW very efficiently and transfer the thermal energy to the reacting precursors for bond breaking and forming. This ultimately leads to NP formation in the IL medium.

The advantage of MW synthetic route was that nanofluids could be prepared by one-step method without the use of additional stabilizing agents. The IoNanofluid exhibited stability for more than one year even in presence of small amount of water content from the reaction medium. This method owes certain advantages like better size control over nanoparticles and avoiding drying and storage steps in between like in two-step nanofluid synthesis processes. The presence of unreacted precursors and counter ions like OH^-, Cl^-, SO_4^{2-} etc in the medium does not offer any disadvantage since it will act as electrolyte around the nanoparticles. However, MW route reduces the concentration of unreacted precursors and improve the nanoparticle yield even from crude $FeSO_4$ liquid. The whole IoNanofluid medium is stabilized by electro-steric stabilization mechanism.

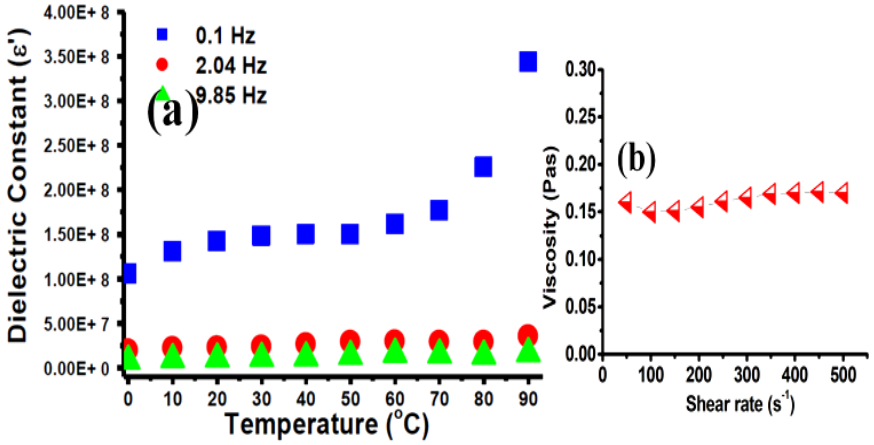

Fig.S2. (a) The plot of dielectric constant versus temperature for the IoNanofluid measured at 0.1, 2.04 and 9.85 Hz applied frequency; (b) Plot of viscosity versus shear rate for the IoNanofluid.

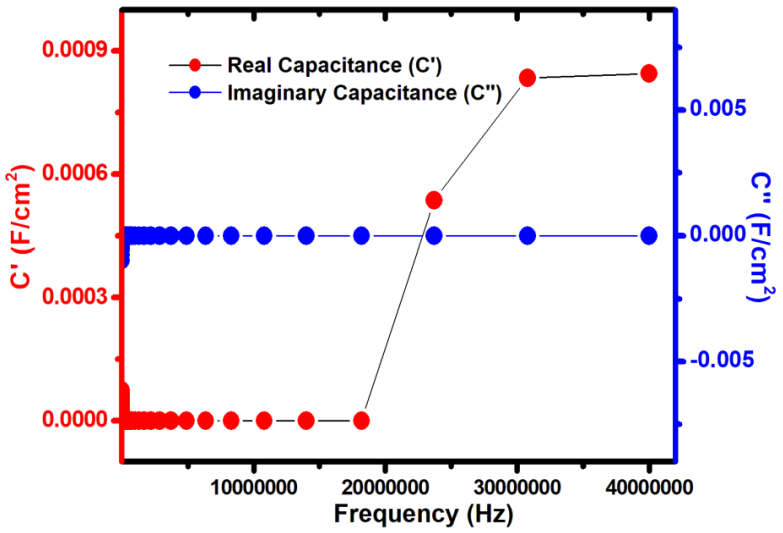

Fig. S3. Plot of real and imaginary capacitance versus frequency of the IoNanofluid obtained from Broadband dielectric measurements.

Calculation of specific capacitance for two-electrode system from CV curve

$$C = 2\frac{\int_{V_a}^{V_b} IdV}{m\nu\,(V_b - V_a)}$$

V_b and V_a are the upper and lower scan limits, $\int_{V_a}^{V_b} IdV$ is the current integral from CV scan, m is mass of the active material (γ-Fe_2O_3) at the electrode surface (0.01132 grams) and ν is the scan rate.

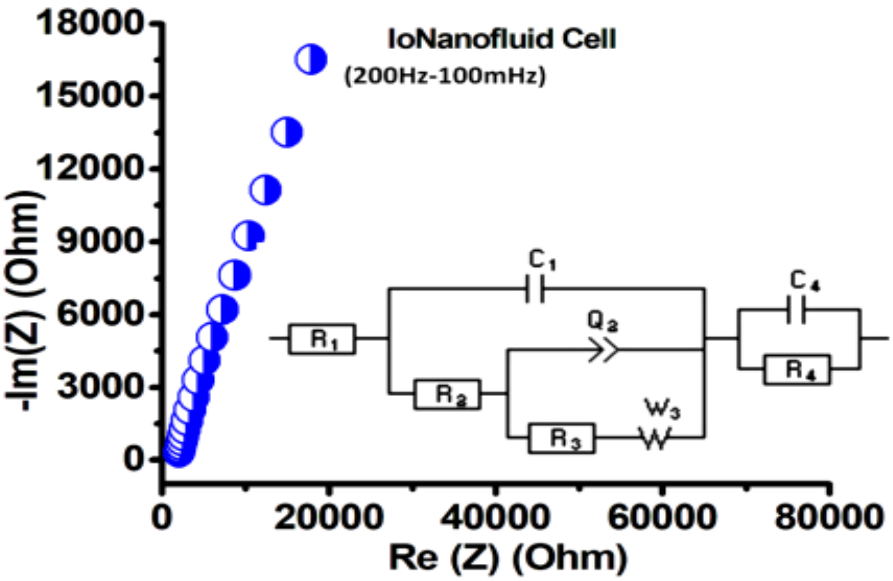

Fig.S4. Nyquist plot and the equivalent circuit of the IoNanofluid cell.

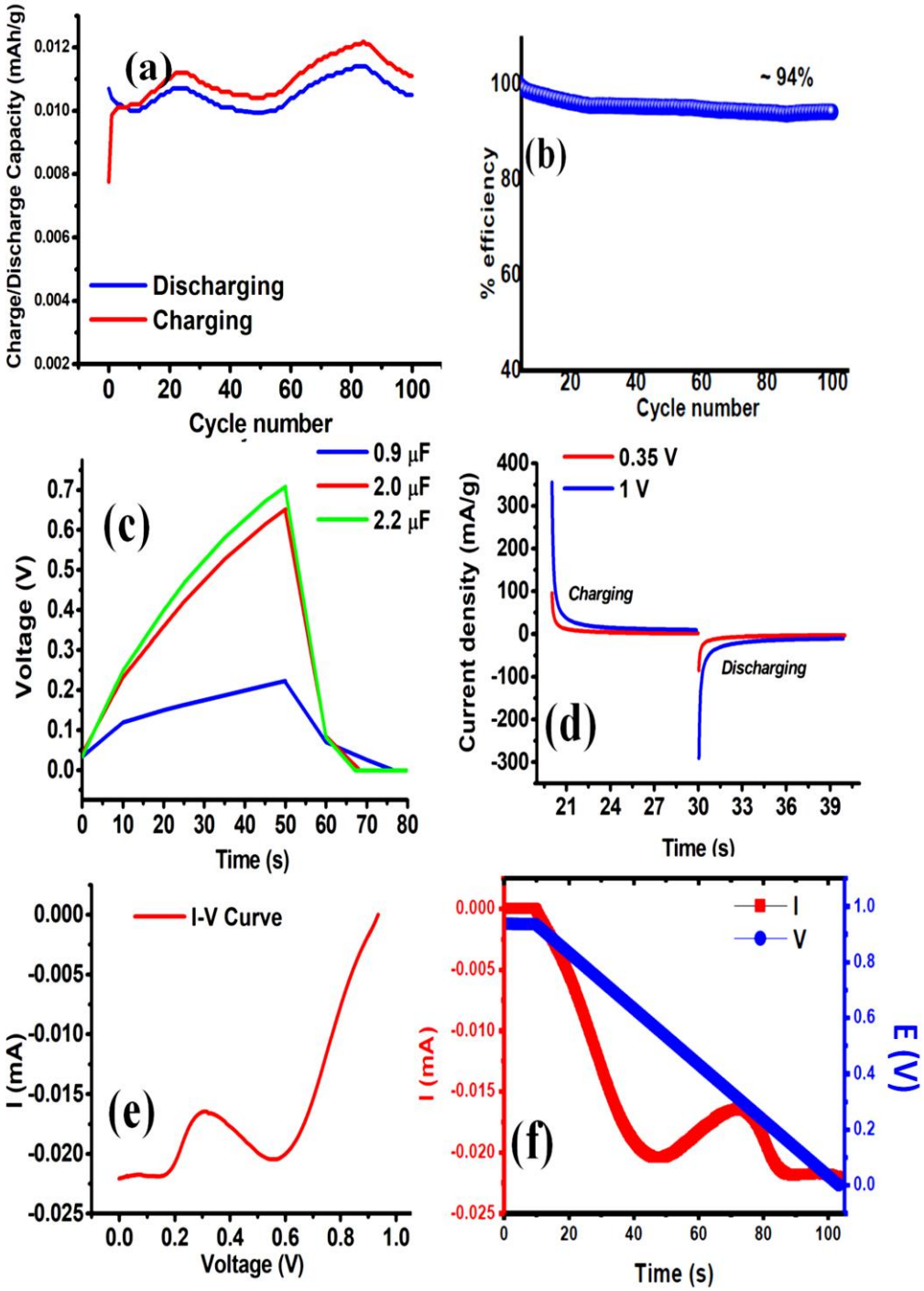

Fig.S5. (a) Plot of charge/discharge capacity versus the number of cycles obtained from chronoamperometry; (b) Plot of % efficiency of charge-discharge process versus number of chronoamperometric cycles; (c) Galvanostatic charge-discharge curves at different current densities; (d) Charge-discharge curves measured from chronoamperometry at an applied potential of 0.35V and 1V; (e) I-V curve of the IoNanofluid electrochemical cell; (f) Variation of current and voltage relative to time during an I-V test.