Supplementary Materials: Separation of Bacteria, Protozoa and Carbon Nanotubes by Density Gradient Centrifugation

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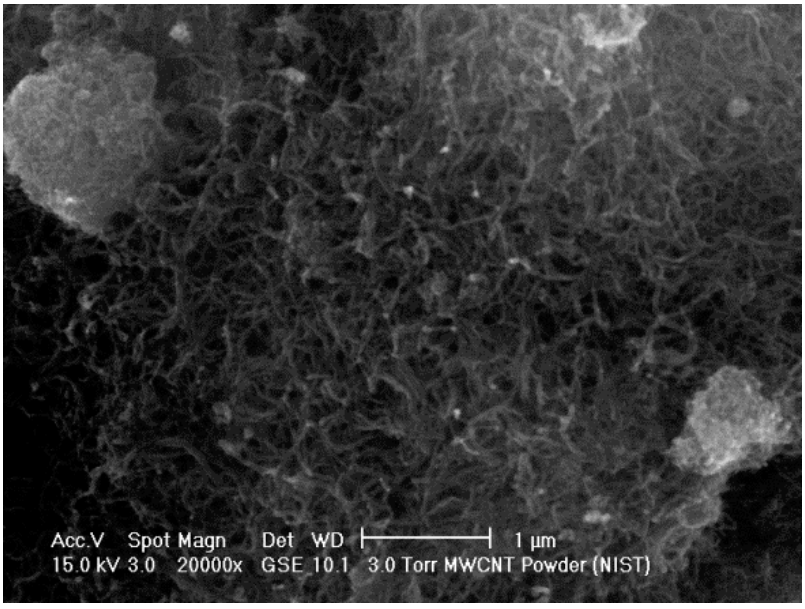
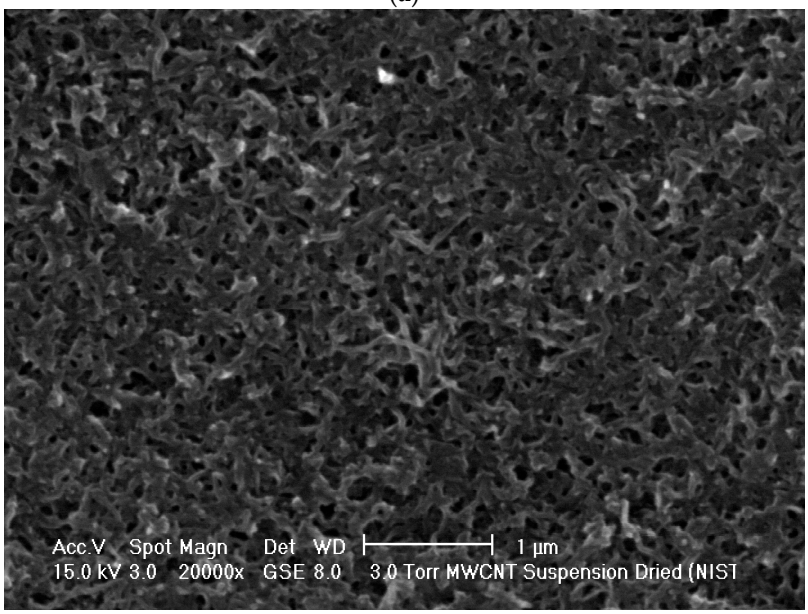


(**a**)



(**b**)

Figure S1. Environmental scanning electron microscopy images of multiwall carbon nanotubes (MWCNTs). (**a**) MWCNT powder; (**b**) probe-sonicated MWCNT suspension, air-dried. Both samples were imaged at a 15-kV accelerating voltage with a gaseous secondary electron detector in wet mode (3 torr); scale bar is 1 µm. MWCNTs appeared less tangled after probe-sonication in Nanopure water, reflected by the overall lower distribution density and less notable bending of MWCNTs (**b**) which likely facilitated their association with bacterial cells.

Table S1. Parameters used in calculating cell and particle diameters in application of Stokes' Law for estimating separation of the system components in various density gradient compositions.

Parameter	Value	Units
Viscosity of water at 20 °C	0.001002 [a]	kg/(m·s)
Density of water at 20 °C	998.2 [a]	kg/m^3
Viscosity of 50% (*w*/*v*) sucrose at 20 °C	0.0062 [b]	kg/(m·s)
Density of 50% (*w*/*v*) sucrose at 20 °C	1176 [b]	kg/m^3
Viscosity of 60% (*w*/*v*) sucrose at 20 °C	0.0155 [b]	kg/(m·s)
Density of 60% (*w*/*v*) sucrose at 20 °C	1230 [b]	kg/m^3
Viscosity of 10% (*w*/*v*) iodixanol at 20 °C	0.00185 [c]	kg/(m·s)
Density of 10% (*w*/*v*) iodixanol at 20 °C	1053 [c]	kg/m^3
Viscosity of 20% (*w*/*v*) iodixanol at 20 °C	0.002 [c]	kg/(m·s)
Density of 20% (*w*/*v*) iodixanol at 20 °C	1107 [c]	kg/m^3
Density of MWCNTs	1500 [d]	kg/m^3
Buoyant density of bacteria in water	1070 [e]	kg/m^3
Buoyant density of bacteria in sucrose	1260 [f]	kg/m^3
Buoyant density of bacteria in iodixanol	1130 [g]	kg/m^3
Buoyant density of protozoa in water	1054 [h]	kg/m^3
Buoyant density of protozoa in iodixanol	1107 [i]	kg/m^3
Density of fecal pellets of protozoa, containing bacteria, in water	1070 [j]	kg/m^3
Density of fecal pellets of protozoa, containing bacteria, in iodixanol	1130 [j]	kg/m^3

[a] Crittenden et al., 2012 [1]; [b] Asadi 2005 [2]; [c] Axis-Shield Applications and Products 2015 [3]; [d] Laurent et al., 2010 [4]; [e] Inoue et al., 2007 [5]; [f] Eroglu and Melis, 2008 [6]; [g] Henriquez et al., 2003 [7]; [h] Harvey et al., 1997 [8]; [i] assumed to be equal to the density of 20% iodixanol based on Axis-Shield Application Sheet C51 [9]; [j] assumed to be the same as density of bacteria in the respective media.

Table S2. Rotor parameters, centrifugal velocities and respective relative centrifugal forces used in the study.

Rotor Type and Model	Rotor Maximum Radius, cm	Revolutions per Minute, rpm	Relative Centrifugal Force (RCF) [a]
Sorvall fixed angle rotor SLA-1500	13.59	2000	607
		8000	9715
Sorvall swinging bucket rotor SH-3000	18.54	3000	1864
		4500	4194

[a] Relative centrifugal force (RCF) was calculated as follows: $RCF = (R_{max}/100) \times (\omega^2)/g$ where R_{max} is rotor maximum radius in centimeters which is divided by 100 to convert to units of meters; ω is the rotor angular velocity (rad/s) which is calculated by multiplying the revolutions per minute (rpm) by $2\pi/60$; g is the constant of gravitational acceleration (9.8 m/s^2).

References

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