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High performance cement/SWCNT thermoelectric nanocomposites and a structural thermoelectric generator device towards large scale thermal energy harvesting

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Supporting Information

Figure S1. SWCNT dispersions (a) immediately after ultrasonication, (b) after t = 24 hours, and (c) after t = 28 days, without any observed aggregates and sedimentation by time.

Figure S2. Thermoelectrical properties over time for the 28 days cement/SWCNT(0.5) sample over 10 minutes.

S1. Stability of SWCNT dispersion over time

The final properties of SWCNT containing nanocomposites show a strong dependence on the extent of the SWCNT dispersion within the cementitious matrix. Therefore, homogeneous, and stable SWCNT/H2O stock solutions need to be developed in advance before mixing with the cement grains. Fig. S1 presents the digital photographs of the SWCNT (SDBS)/H2O dispersion right after 60 min of tip sonication, as well as their stability over 24 hours and up to 28 days. Sonication energy of ~8kJ for 60 min in this study allowed to achieve a uniform SWCNT aqueous dispersion, especially SWCNT(SDBS)/H2O mixtures, without any visible aggregates and observed precipitation over time (dispersions prepared for up to 0.5 wt.% SWCNT content cement nanocomposites); rendering thus a highly conductive and dense SWCNT network in the cement matrix with extended CNT-CNT junctions and numerous carrier transport pathways.

The stability of the SWCNT dispersion with adsorbed amphiphilic surfactant molecules on their surface is guaranteed by electrostatic and/or steric repulsion forces as reported elsewhere. [1] It is also worth mentioning that a homogeneous dispersion and disentanglement of SWCNTs in water is hard to achieve, due to their extremely high tendency towards agglomeration via Van der Walls forces and π-π stacking interactions. [2]

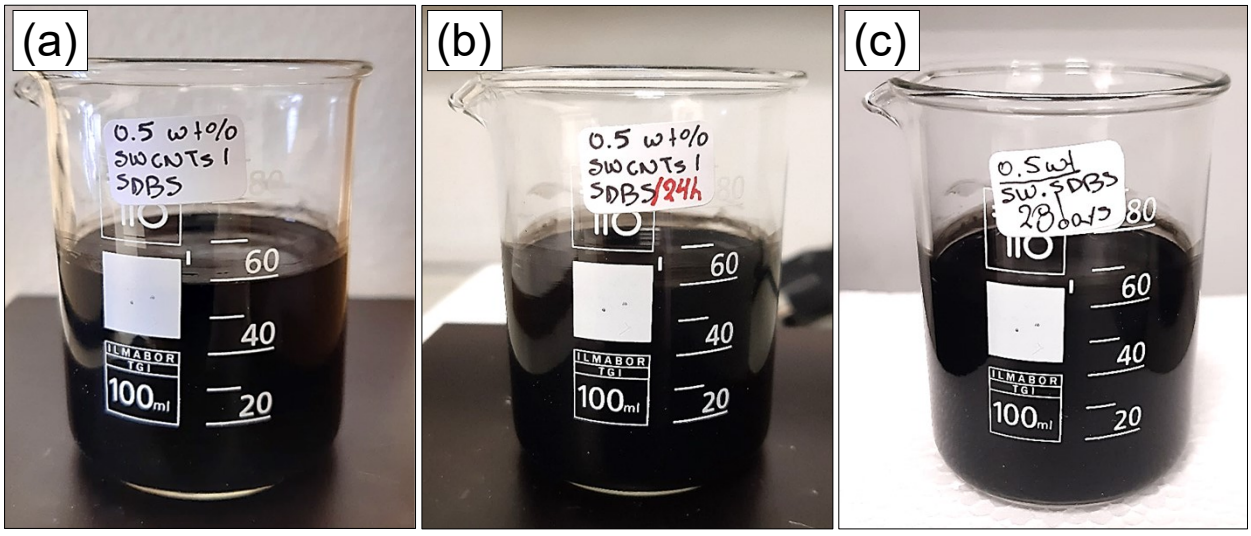

Figure S1. SWCNT dispersions (a) immediately after ultrasonication, (b) after t = 24 hours, and (c) after t= 28 days, without any observed aggregates and sedimentation by time.

S2. Thermoelectric properties of cement/SWCNT nanocomposites

The Seebeck coefficients reported in this study are those at a steady state, after 5 minutes of exposing the cementitious nanocomposites to a thermal difference (ΔT). However, in figure S2 a thermoelectrical property decay over 10 min of a cement/SWCNT(0.5) single thermoelement is depicted. As it can be seen, already from the first 5 minutes, the values have reached a steady-state.

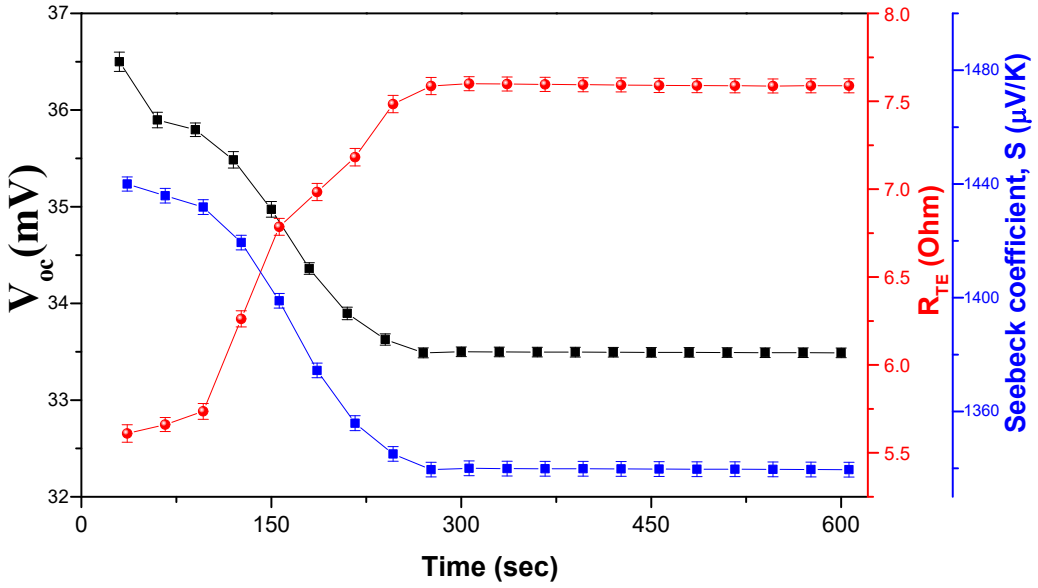

Figure S2. Thermoelectrical properties over time for the 28 days cement/SWCNT(0.5) sample over 10 minutes.

1. L. Tzounis, M. Zappalorto, F. Panozzo, K. Tsirka, L. Maragoni, A. S. Paipetis and M. Quaresimin, *Composites Part B: Engineering*, 2019, **169**, 37-44.
2. L. Tzounis, M. Kirsten, F. Simon, E. Mäder and M. Stamm, *Carbon*, 2014, **73**, 310-324.