Electronic Supplementary Information

Results and discussion

Organic/inorganic hybrid nanocomposites have attracted great attention today due to their superior properties.[1,2] Increased matrix-nanofiller interaction improves cost savings and ameliorates certain characteristics of a developed nano-materials.[2,3] The tailored system of applying SFO-based hyperbranched alkyd/spherical ZnO nanocomposites for anticorrosive purposes was verified in this work.
The newly developed series of SFO-based hyperbranched alkyd/spherical ZnO nanocomposites based alkyd composites were studied to proof the chemical interaction between the as-synthesized SFO-based hyperbranched alkyd resin and the designed size and morphology of nano-ZnO. ^{1}HNMR spectrum of the as-synthesized SFO-based hyperbranched alkyd resin is illustrated in Fig. S1. It distinguish signals of chemical shift at (A) 0.95–1.3 (CH_3- TMP and SFO fatty acids), that at 1.6–2.7 ppm which is due to (CH_2 and CH-fatty acids), that at 4.4 is due to (CH_2- OR) and that at 5.30 is due to (- CH=CH-) of the unsaturated fatty acids. GPC measurements of the prepared hyperbranched polyester and SFO-based hyperbranched alkyd resins were illustrated in Fig. S2 (A and B). The distribution of SFO fatty acids in the hyperbranched alkyd resin caused an increase in the PDI values. The well-distribution of the prepared nano-ZnO spheres is indicated in HRTEM images of the prepared SFO-based hyperbranched alkyd/spherical ZnO nanocomposites (Fig. S3 A and B). The well-distribution of nanofillers increases the surface area of the NPs and enhances polymer-NPs interaction. On the other hand, the agglomeration and aggregation of the NPs inside the tailored nanocomposites at high concentrations (5% nanofillers) are illustrated in Fig. S3(C and D). It is clear that at high concentration the particles are condensed over each other's reducing the surface area and polymer-NPs interactions. Thus, the mechanical physico-chemical and anticorrosive properties were reduced. The thermal stability of the cured virgin and nanocomposites were indicated through temperature of onset (T_i) and temperature of maximum (T_{max}). Table S1 indicate the measurements of $T_{10\%}$, $T_{50\%}$, T_i and T_{max}. The results indicated the increase in thermal stability with nanofiller loading up to 0.5% ZnO nanofillers, while at higher concentrations (1-5%) the thermal stability was decreased gradually. Studying the rheological characteristics is essential for paint application. The prepared SFO-based hyperbranched alkyd resin follow a Newtonian performance[4,5]. This behaviour refers to the low hydrodynamic volume caused by high packing and the loss of entanglement. This action was confirmed for other hyperbranched polymers as mentioned in literature. This indicates the low viscosity which is measured at $0.11 s^{-1}$ with shear rate of 0.069 Pa s. This value is lower than the commercial linear alkyd resins (1.48 Pa s).[6]

ESI Figures:

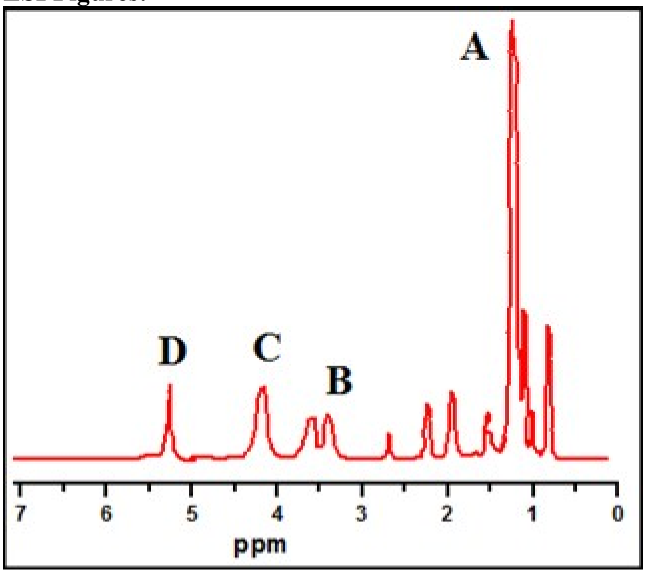

Figure S1: ^{1}HNMR spectrum of the prepared SFO-based hyperbranched alkyd resin.

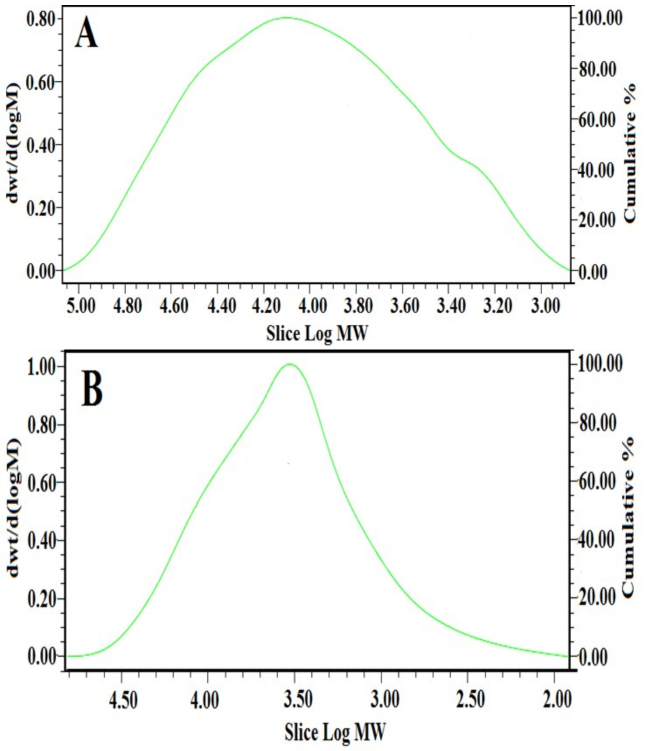

Figure S2: (A) MW distribution of the prepared hyperbranched polyester; (B) MW distribution of the as-synthesized SFO-based hyperbranched alkyd resin.

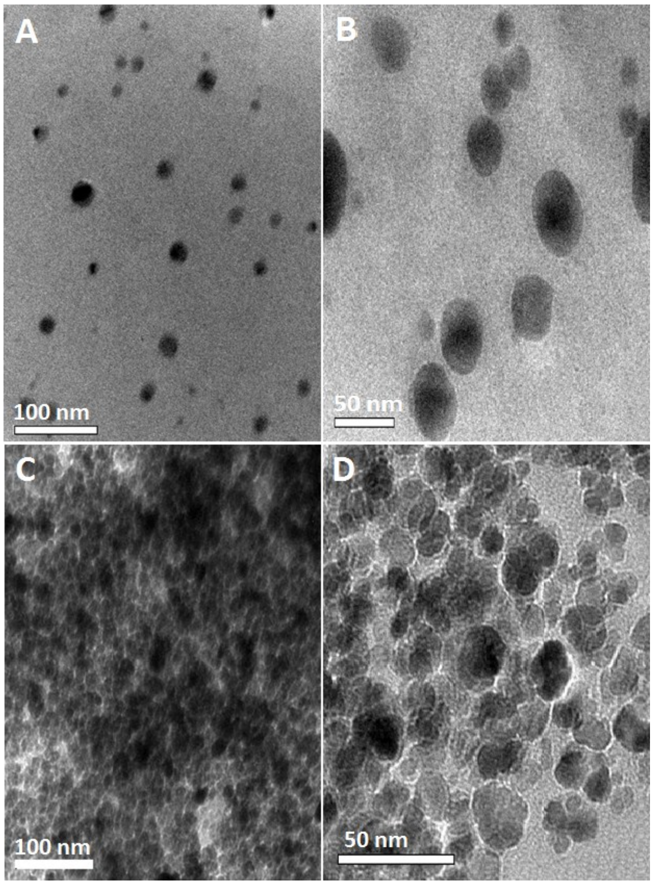

Figure S3: (A) and (B) corresponding TEM images of the prepared SFO-based hyperbranched alkyd/spherical ZnO nanocomposites for low concentration (0.5% nanofillers), while (C) and (D) are the TEM images of the prepared SFO-based hyperbranched alkyd/spherical ZnO nanocomposites at high concentration (5 % nanofillers).

Table S1: Thermal stability of unfilled and filled SFO-based hyperbranched alkyd/spherical ZnO nanocomposites.

Cured films & (nanofillers %)	$T_{10\%}$	$T_{50\%}$	T_i	T_{max}
SFO-based hyperbranched alkyd film	246	386	297	448
SFO-based hyperbranched alkyd/spherical ZnO nanocomposites (0.1% nanofillers)	302	395	320	462
SFO-based hyperbranched alkyd/spherical ZnO nanocomposites (0.5% nanofillers)	338	408	345	468
SFO-based hyperbranched alkyd/spherical ZnO nanocomposites (1% nanofillers)	315	393	340	463
SFO-based hyperbranched alkyd/spherical ZnO nanocomposites (3% nanofillers)	308	391	318	458
SFO-based hyperbranched alkyd/spherical ZnO nanocomposites (5% nanofillers)	302	388	304	452

References:

[1] M. S. Selim, S. A. El-Sockary, M. A. El-Sockary, A. I. Hashem, O. M. Abo Elenien, A. M. EL-Saeed and N. A. Fatthallah, *RSC Adv.* 2015, 5(26), 19933–19943.
[2] M. S. Selim, S. A. El-Safty, M. A. El-Sockary, A. I. Hashem, O. M. Abo Elenien, A. M. EL-Saeed, N. A. Fatthallah, *RSC Adv.,* 2015, 5; 63175-63185. [3] M. S. Selim, S. A. El-Safty, M. A. El-Sockary, A. I. Hashem, O. M. Abo Elenien, A. M. EL-Saeed, N. F. Fatthallah. *Mater Design., 2016,* 101, 218-225.
[4] A. Bat, G. Gunduz, D. Kisakurek, I.M. Akhmedov, Prog. Org. Coat., 2006, 55, 330-336.
[5] T. T. Hsieh, C. Tiu, G. P. Simon, Polymer, 2001, 42, 1931-1939.
[6] V. C. Patel, J. Varughese, P. A. Krishnamoorthy, R. C. Jain, A. K. Singh, M. Ramamoorty, *J. Appl. Polym. Sci.*, 2008, 107, 1724-1729.

