

Electronic Supplementary Information:

Analysis

The optical micrographs of the immersed coated glass samples (in bacterial strains) have been imaged through (Olympus BH-2, Japan) polarized microscope.

Results and discussion

The designed technique of using silicone/nobel metal nanocomposites for FR coatings was verified in this work. The tailored spherical Ag/silicone NCs were studied to proof the chemical interaction between the prepared VTPDMS and the selected morphology of nanosilver particles. SEM images of the prepared spherical Ag NPs were illustrated in (Figure S1 A and B). The well dispersion of NPs is illustrated in TEM images of the prepared spherical Ag/silicone nanocomposites (Figure S1 C, D and E) while the agglomeration and aggregation were illustrated as in Figure (S1 F, G and H) for 5% Ag NPs. The polarized optical microscope confirmed the surface and FR effectiveness through biofilm coverage of spherical Ag/silicone nanocomposites at various loading concentrations after exposure to bacterial strains (Figure S2). The surface coverage of the darker zone (fouled) to the whole film is the bacterial coverage. At lower concentration of spherical Ag NPs up to 0.1% the surface is shown to be homogenous with nearly no fouling adhesion. On contrary, the unhomogeneity and densely fouled samples observed for the higher concentrations up to 5% were due to agglomerations and particle clustering which facilitate fouling settlement and decrease the surface performance. Field exposure test was applied on the prepared unfilled PDMS films (as a control sample) as illustrated in Figure S3 where three types of fouling were observed, slime, algae and animals. Comparison of the filled PDMS coating with the developed model of PDMS/spherical Ag nanocomposites (0.1% nanofillers) has approved the superior FR properties of the tailored nanocomposites. The mechanical tests of the unfilled PDMS, 0.1% Ag filled silicone nanocomposites and the total formulations were measured and reported in table S1.

Applicability of FR coating system based on spherical Ag NPs

To explore the real applicability of nanofiller model design, the FR performance of the newly fabricated PDMS/spherical Ag nanocomposites (0.1% because of its superior properties) in terms of surface free energy and surface hydrophobicity was compared with the following models:

- 1) Two commercial FR silicone coatings, namely, Sylgard® 184 (hydrosilation cured PDMS) and RTV11 (condensation cured PDMS) (Dow Corning company products used extensively as marine FR coating)
- 2) Synthetically modeled design based on Sylgard 184/multi-wall carbon nanotubes (MWCNT)
- 3) Our previous fabricated FR model based on Cu₂O silicone nanocomposite, see Ref 16.

Figure 4 A shows that Sylgard 184 exhibited high hydrophobicity and stability in water, whereas RTV11 showed low hydrophobicity and stability in water.⁴⁵ The comparison of the

static contact angle data from these two coatings showed that Sylgard®184 silicone (104°) introduced higher contact angles than RTV11 coatings (100°).⁴⁸ In addition, the surface energy of RTV11 (approximately 23.3 mJ/m²) was slightly higher than that of Sylgard® 184 silicone (20 mJ/m²). Thus, Sylgard® 184 was more effective in resisting fouling adhesion than RTV11. Sylgard 184 was modified with multi-wall carbon nanotubes (MWCNT) (up to 0.2% nanofillers) and speolites (from 0 to 10%) to enhance surface energy and FR properties. After modification, the surface free energy decreased to 18 mJ/m² but the water contact angle only slightly changed. The filled coatings were more hydrophobic than the unfilled ones, and thus presented higher tendency to retard fouling.⁴⁶ Silicone/Cu₂O nanocomposites were modeled, and the results showed that 0.1% Cu₂O nanofiller was more effective in terms of FR performance compared with RTV11 and modified Sylgard®184; the contact angle increased up to 130°, and the surface free energy decreased (approximately 14.1 mJ/m²).¹⁶

ESI Figures:

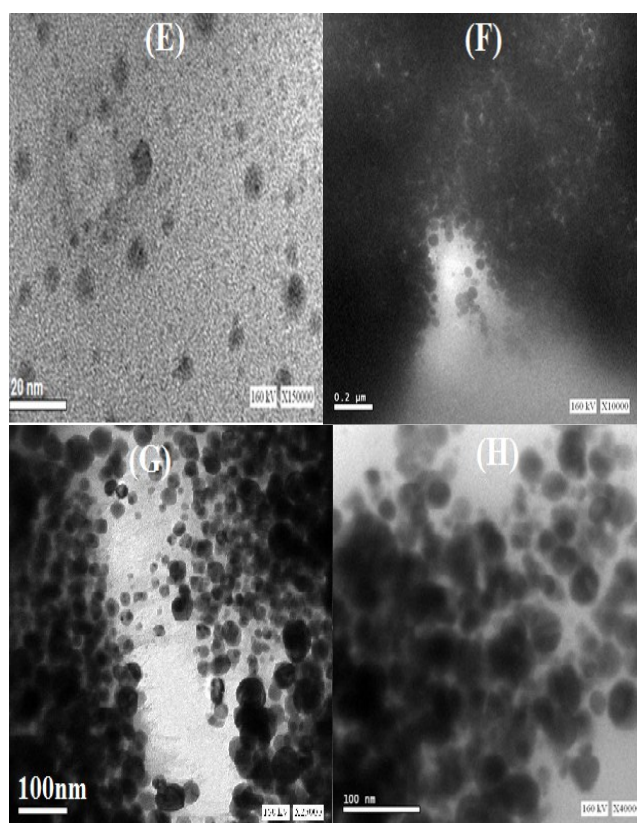
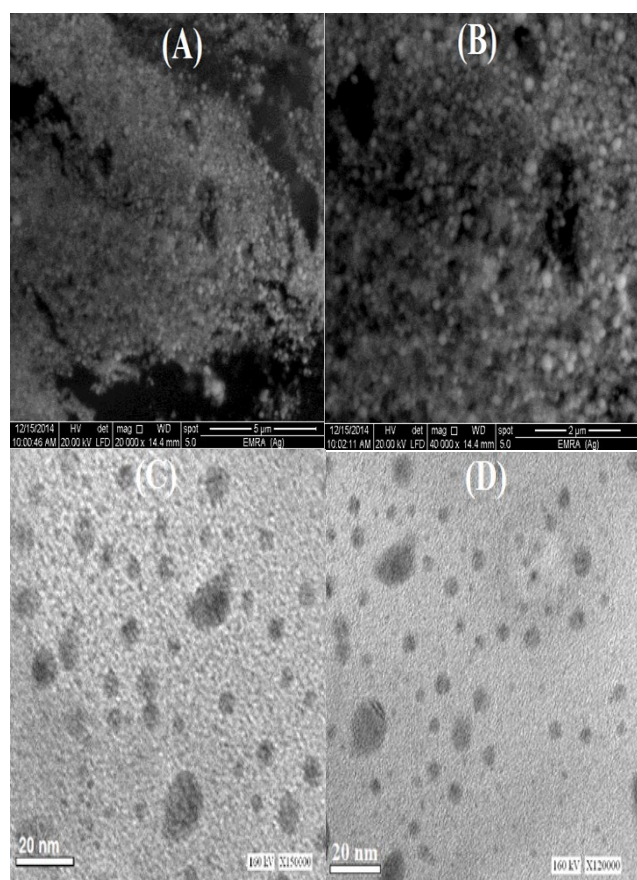
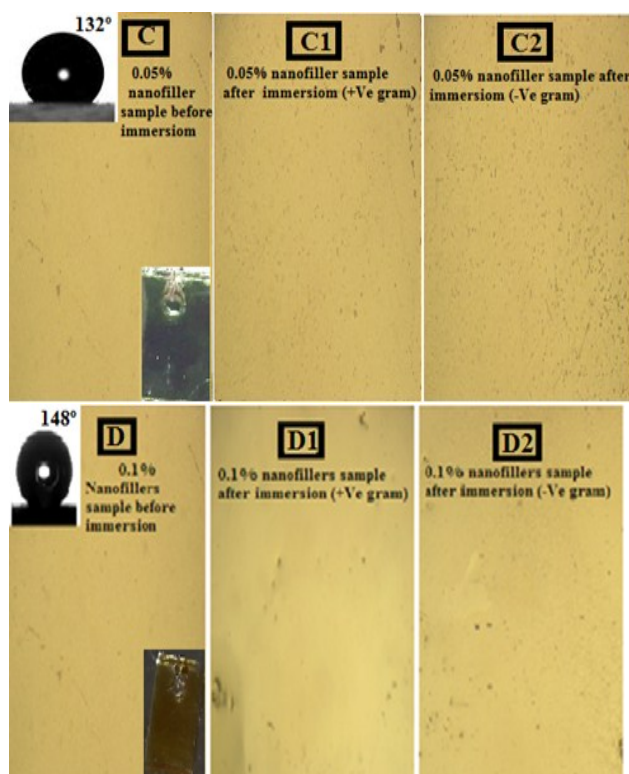
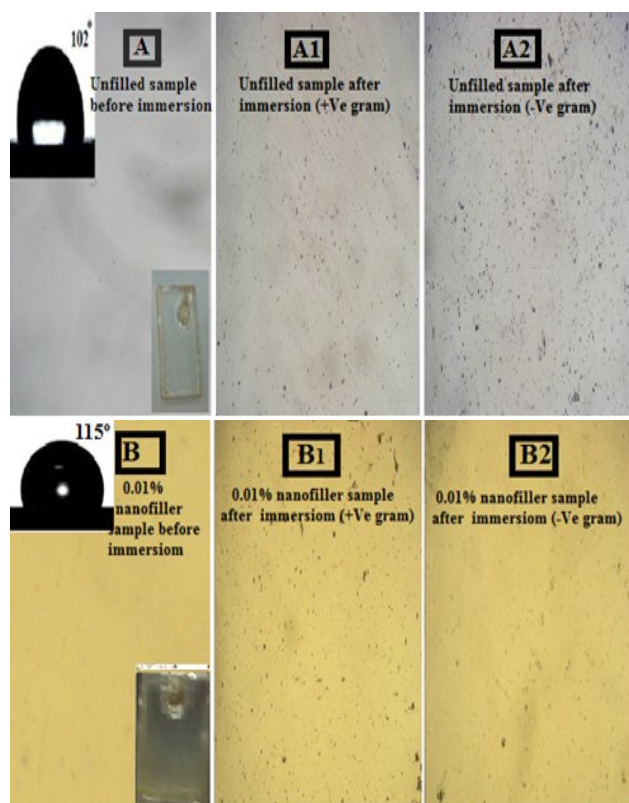


Figure S1: (A) and (B) corresponding SEM images of the as-synthesized Ag NPs; (C) (D) and (E) are the TEM images of the PDMS/Ag nanocomposites (0.1% nanofillers); and (E) (F) and (G) are the TEM images of the PDMS/spherical Ag nanocomposites (5% nanofillers).





Fig

ure S2: Optical microscope images (A), (A1) and (A2) of the unfilled PDMS; (B), (B1) and (B2) of the 0.01% nanofillers in the PDMS/Ag nanocomposites; (C), (C1) and (C2) of the 0.05% nanofillers in the PDMS/Ag nanocomposites; (D), (D1) and (D2) of the 0.1% nanofillers in the PDMS/Ag nanocomposites; (E), (E1) and (E2) of the 0.5% nanofillers in the PDMS/Ag nanocomposites; (F), (F1) and (F2) of the 1 % nanofillers in the PDMS/Ag nanocomposites; (G), (G1) and (G2) of the 3% nanofillers in the PDMS/Ag nanocomposites; (H), (H1) and (H2) of the 5% nanofillers in the PDMS/Ag nanocomposites; all before and after immersion in bacterial strains for 30 days.

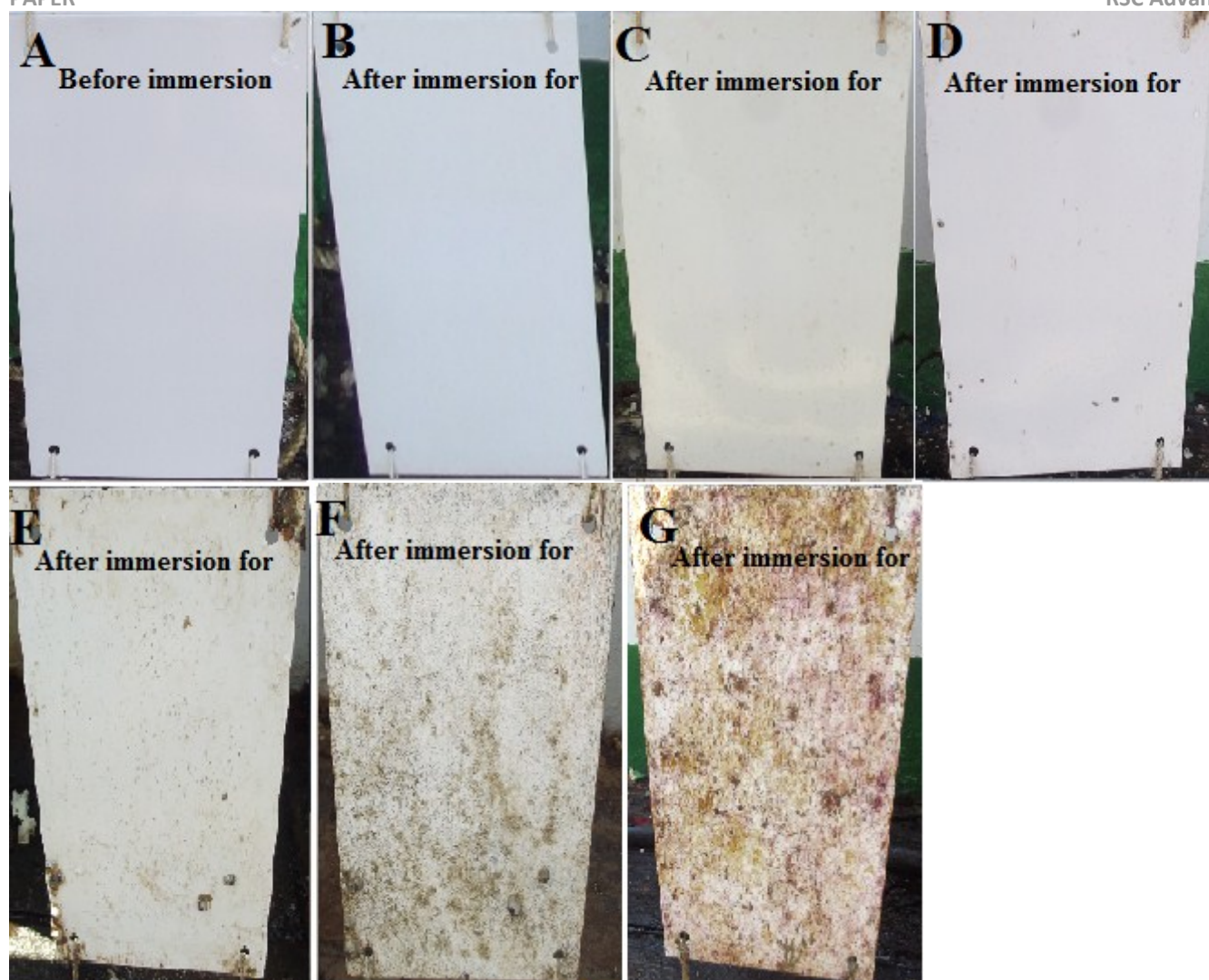


Figure S3: (A)–(G) Field test results of the unfilled synthesized PDMS films for 12 months of immersion in natural sea water.

Table S1: Mechanical tests of unfilled, (0.1%) Ag filled and the designed formulations.

Sample Design	Crosshatch test	Bending test (mm)	Impact test (J)
PDMS blank	Pass	< 5	5
PDMS/Ag NCs (0.1%)	Pass	< 5	8
Complete nanocomposite formulation	Pass	< 5	10