Modification and characterization of an Iranian montmorillonite as a corrosion/mechanical promoter for epoxy coatings

Supplementary Material

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Image processing was employed to quantitatively investigate how black regions indicating MMT platelets were distributed in the coating images. For this purpose the TEM images were divided into four, nine, and 16 sub-images (Fig. S1). Then, the average of pixels’ intensities was calculated for each sub-image (colored bars in Fig. S2,). Then, the standard deviation (STD) of four, nine, and 16 sub-images average intensities were calculated (gray bars in Fig. S2). The smaller the difference between sub-images average intensities (i.e. lower standard deviation) the more uniform the distribution of black regions (i.e. MMT layers) in the coating. Each sub-image of divided micrographs into four, nine and 16 parts, represent a 550×550, 366×366 and 275×275 nm2 of total coating area, respectively. The difference between four sub-images average intensities for EP-OMMT3 micrograph is lower than that of EP-MMT3 (Fig. S2A). In addition, the standard deviations of four sub-images average intensities were 11.68 and 15.88 for EP-OMMT3 and EP-MMT3 micrographs respectively. These results indicate that the dispersion state of EP-OMMT3 in 550×550 nm2 scale in coating is ((15.88-11.68)/15.88)×100 = 26 percent more uniform than that of EP-MMT3. The same trend was obtained for divided micrographs into nine and 16 parts. The standard deviation of nine and 16 sub-images average intensities were 12.89 and 14.76 for EP-OMMT3 and 19.53 and 22.20 for EP-MMT3 respectively (Fig. S2B and S2C). The EP-OMMT3 is better dispersed compared to EP-MMT3 by 34 % and 40 % in 366×366 nm2 and 275×275 nm2 scale in coatings, respectively. Clearly, as the evaluation scale (i.e. sub-image size) becomes smaller, the difference between dispersion properties of EP-OMMT3 and EP-MMT3 samples becomes more significant.



Figure S1. Quantitative estimation of MMT layers dispersion in EP-OMMT3 and EP-MMT3 samples using TEM image processing. TEM images of EP-OMMT3 and EP-MMT3 were divided into four, nine, and 16 sub-images and average of pixels’ intensities were calculated for each sub-image.



Figure S2. TEM image processing results. Average of pixels’ intensities for each sub-image has been presented (colored bars). Standard deviation of colored bars has been presented as well (gray bars). Number of sub-images was (A) four, (B) nine, and (C) sixteen.