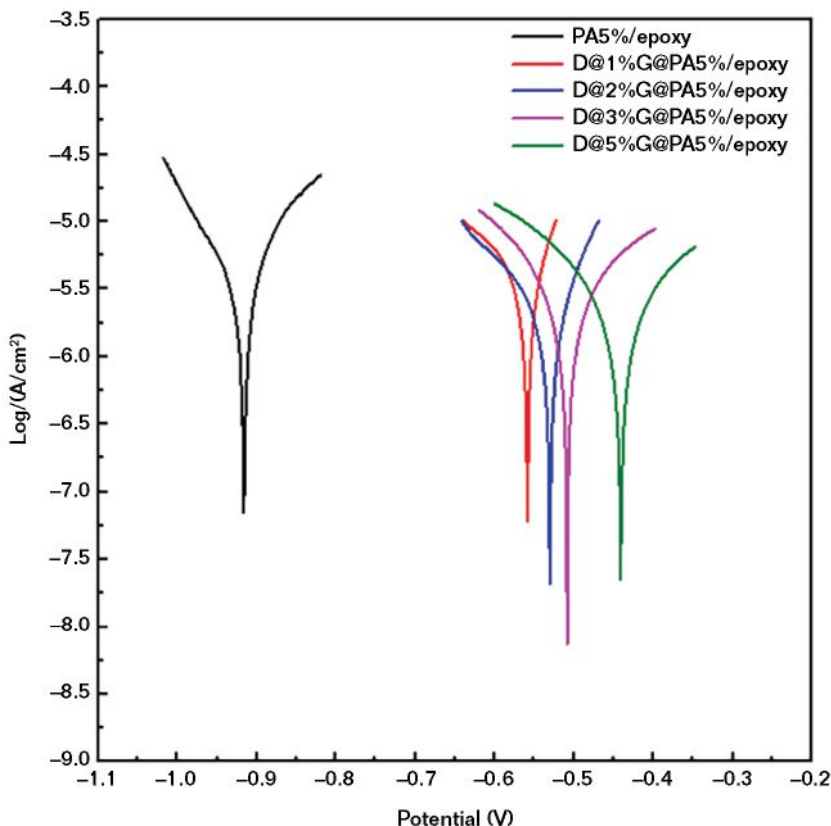
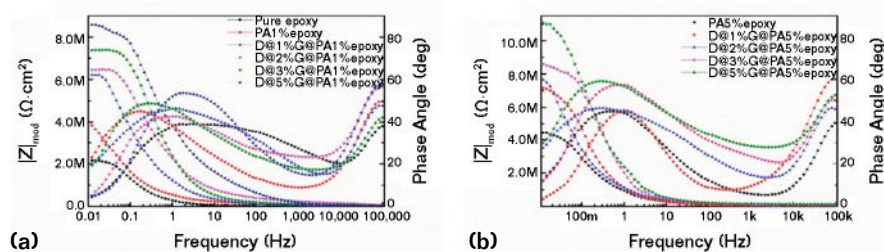


**TABLE 1. ELECTROCHEMICAL PARAMETERS FOR THE COMPOSITE-COATED STEEL SAMPLES**

Sample	Pure Epoxy	PA1%-Epoxy	PA3%-Epoxy	PA5%-Epoxy	D@5%G@PA1%-Epoxy	D@5%G@PA3%-Epoxy	D@5%G@PA5%-Epoxy
$E_{corr}/V$	-1.084	-0.994	-0.951	-0.916	-0.452	-0.493	-0.441
$I_{corr}/A (10^{-7})$	52.7	83.2	36.4	17.7	2.24	8.73	0.832



**FIGURE 3** Polarization curves of epoxy coatings with 5 wt% PA and DBSA@x%G@PA composite (x = 1, 2, 3, and 5), respectively.



**FIGURE 4** EIS curves for the epoxy coating and doped coatings. Bode plots of epoxy coatings without and with 1 wt% (a), and 5 wt% (b) D@x%G@PA composite at the beginning immersion in 3.5 wt% NaCl solution.

Based on the fact that the corrosion rate is inversely proportional to the value of impedance modulus at low frequency,<sup>13</sup> it can be concluded that the epoxy resin with PA showed better corrosion resistance. The

value of the impedance modulus of the epoxy with 1 wt% D@1%G@PA composite was 6.0 MΩ cm<sup>2</sup> (Figure 4[a]), which is almost three times that of the epoxy resin, indicating a great improvement in the cor-

rosion resistance. The enhanced corrosion resistance was probably attributed to the excellent barrier of the GNS toward corrosive species. The value of the impedance modulus of the coating with 1 wt% D@2%G@PA, D@3%G@PA, and D@5%G@PA composite was 6.2, 7.5, and 8.5 MΩ cm<sup>2</sup> (Figure 4[a]), respectively, suggesting that the corrosion resistance increased with increasing GNS. The value of the impedance modulus of composite coating with 5 wt% D@5%G@PA5 was 10.5 MΩ cm<sup>2</sup> (Figure 4[b]), larger than that of the other composite coating, indicating an effective anticorrosion property.

### Conclusions

A series of D@x%G@PA composite materials was prepared and characterized. The D@%G@PA composite was used as filler to prepare composite coatings. EIS result showed that the  $I_{corr}$  of the coating with 5 wt% D@5%G@PA composite was as low as  $8.32 \times 10^{-8} A cm^{-2}$ . The value of the impedance modulus of epoxy coating with 5 wt% D@5%G@PA was 10.5 MΩ cm<sup>2</sup>, larger than that of the other composite coating, indicating the effective anticorrosion property. All of the samples coated with composite exhibited significantly lower corrosion rates than the epoxy sample.

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