Supporting Information

Efficient Anti-corrosive Coating of Cold-rolled Steel in Seawater Environment using Oil-based Graphene oxide Ink

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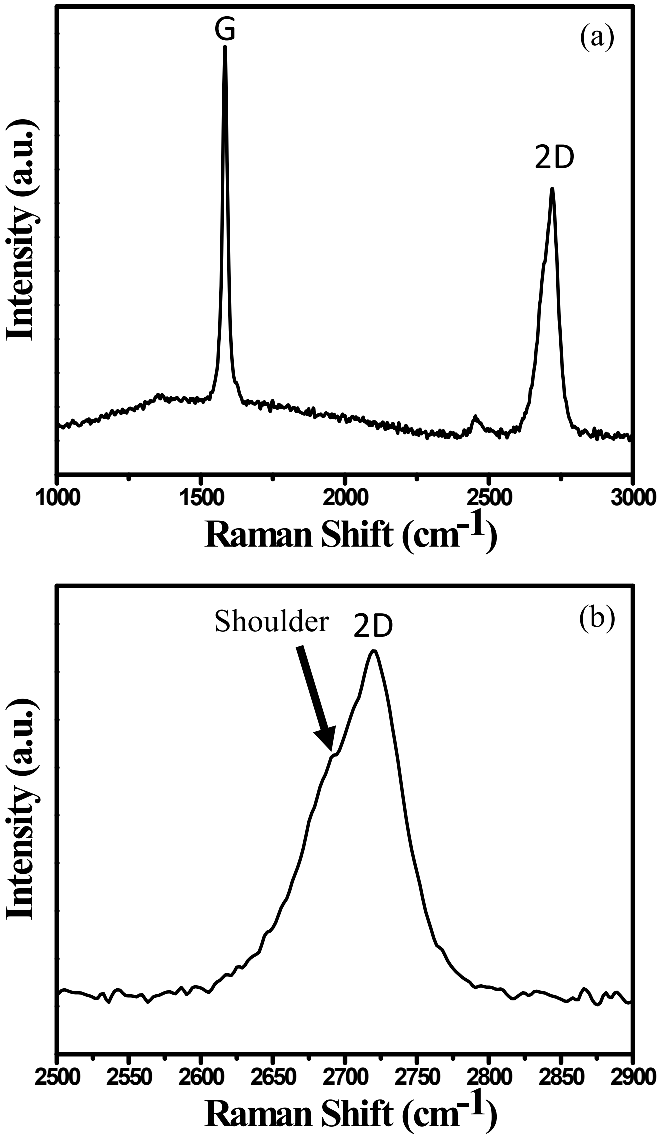

Fig. S1 (a) The Raman data of commercial graphite powder (Alfa Aesar). (b) The 2D peak is separately plotted to show the shoulder of the peak.

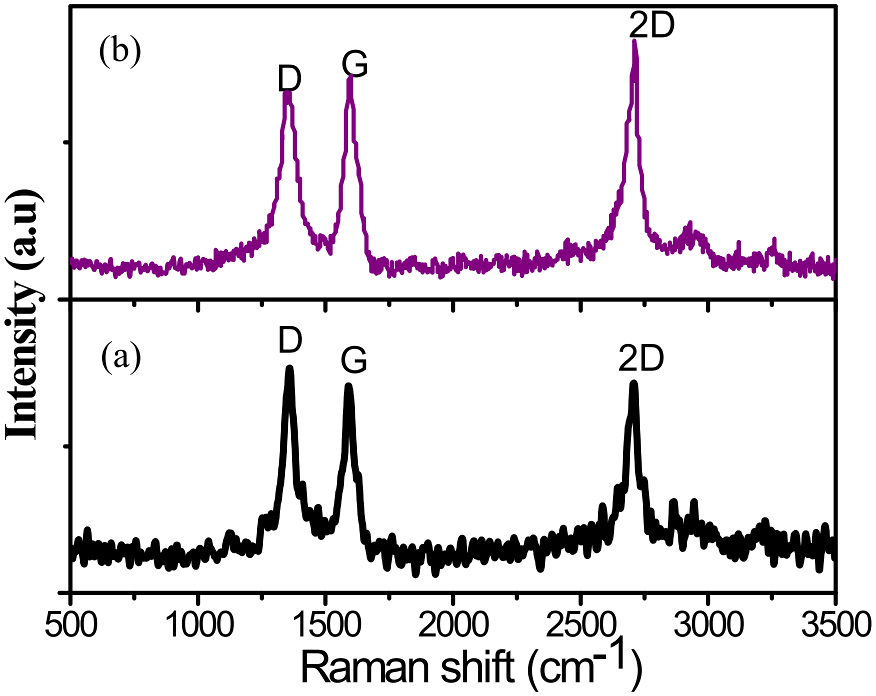

Fig. S2 Raman spectra of the prepared under the optimized heating temperature and time; (a) graphene oxide and (b) Ni added graphene oxide from the AA plant.

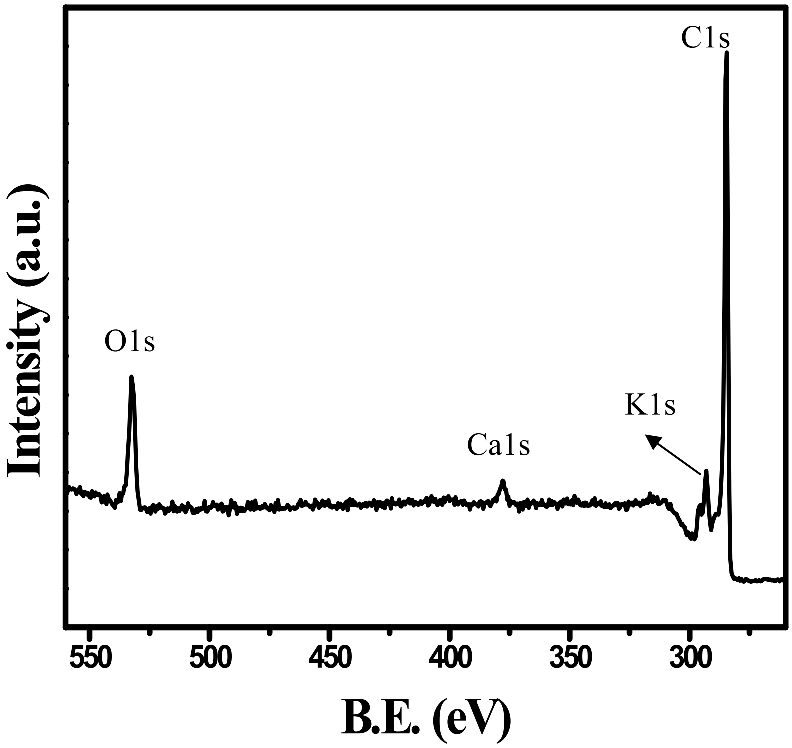

Fig. S3 The XPS spectrum of the obtained graphene oxide by heating the AA plant at 1000 °C. The spectrum shows the Ca1s, K1s and strong O1s peak.

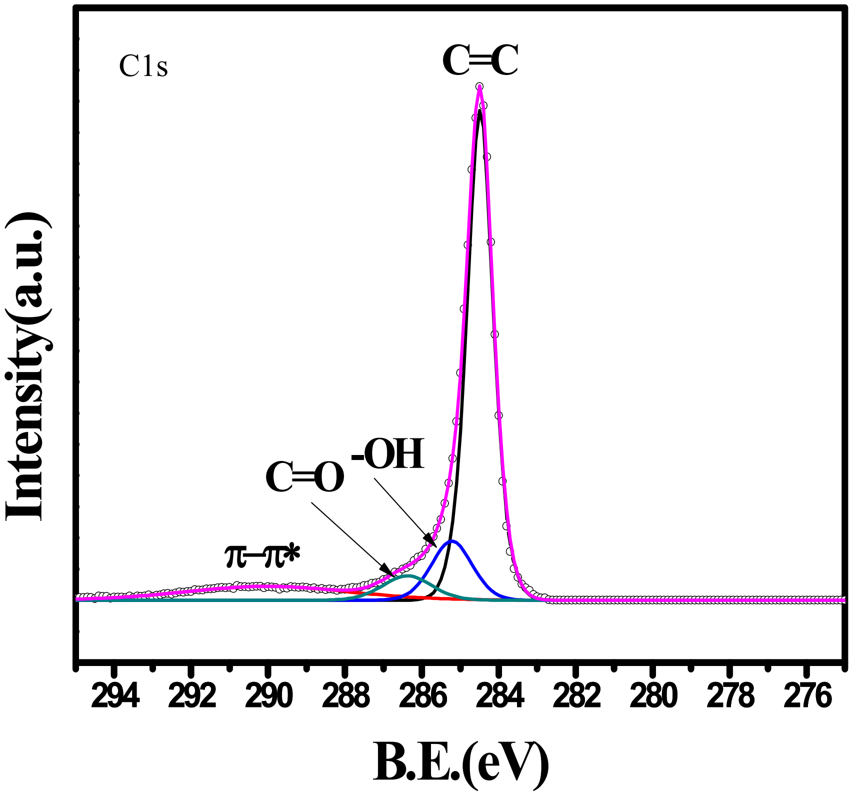

Fig. S4 Shows the deconvoluted C1s XPS spectrum of the obtained graphene oxide by heating the AA plant at 1600 °C for 1 h.

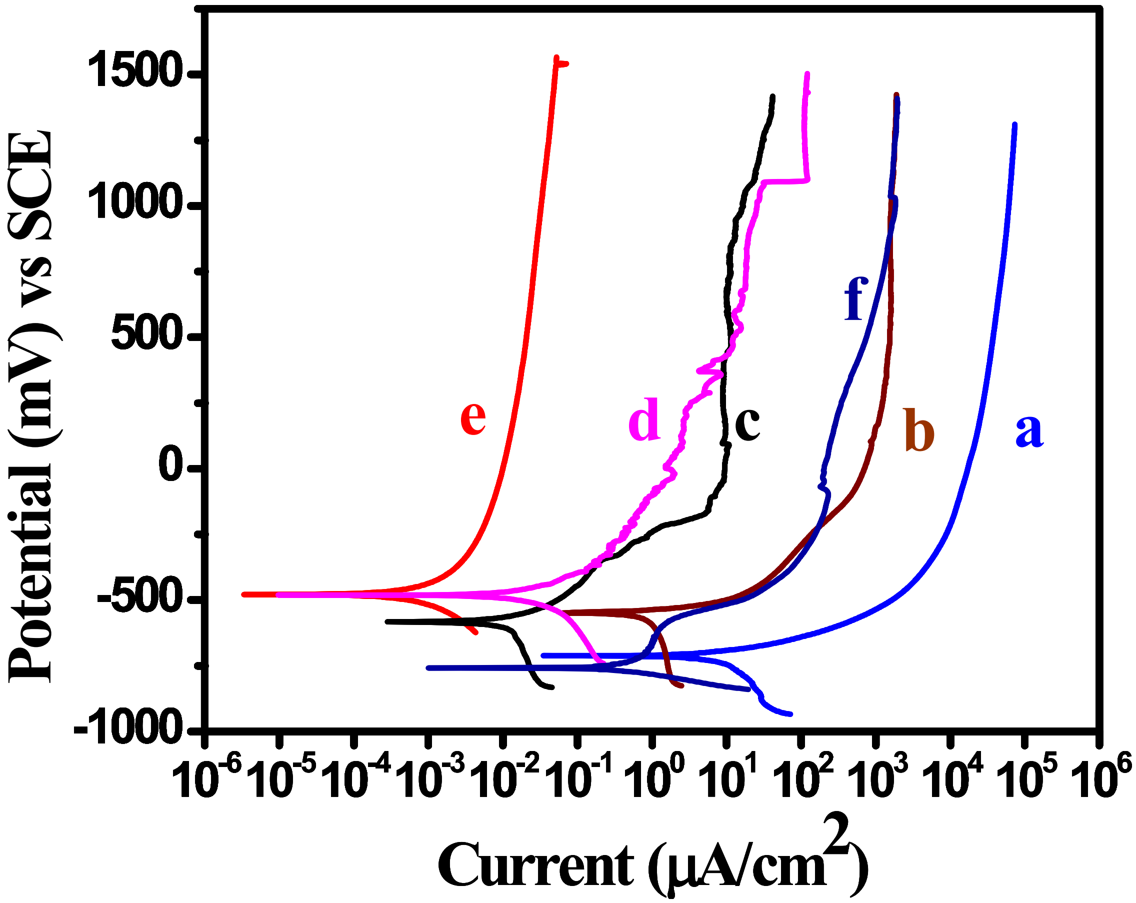

Fig. S5 Shows the potentiodynamic polarization curves of ink coated CR steel as a function of loading.(a) bare,(b) oil, (c) 0.5 g, (d) 1 g, (e) 1.5 g and (f) 2 g graphene oxide.

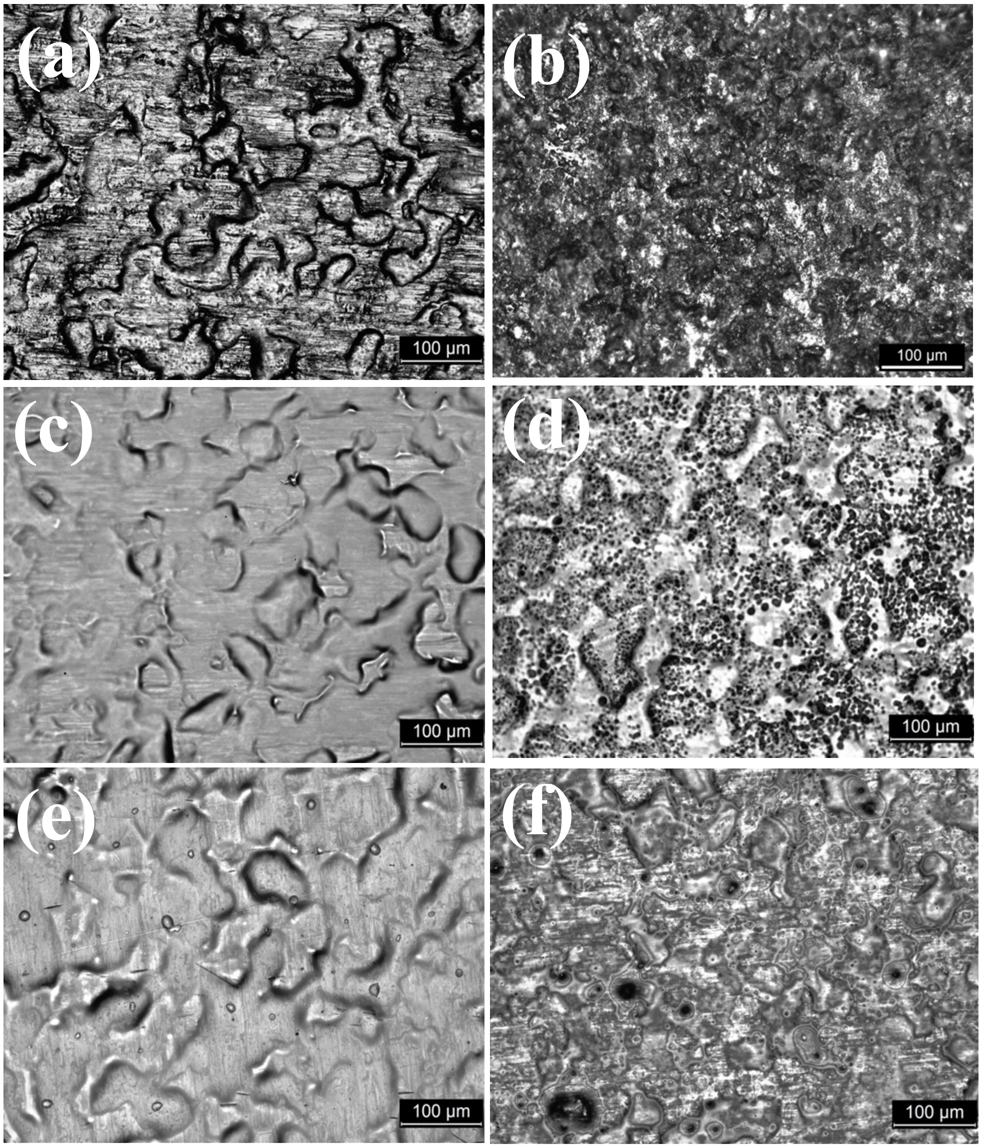

Fig. S6 Depicts the optical image of the CR steel substrates before and after polarization test; (a, b) bare, (c, d) oil coated and (e, f) ink coated. The images show that there is almost no dissolution of CR steel in the case of ink coating, whereas the mild dissolution is observed in the case of oil coated CR steel and severe dissolution in the case of the bare CR steel (black spots of the polarized substrate are damaged area).

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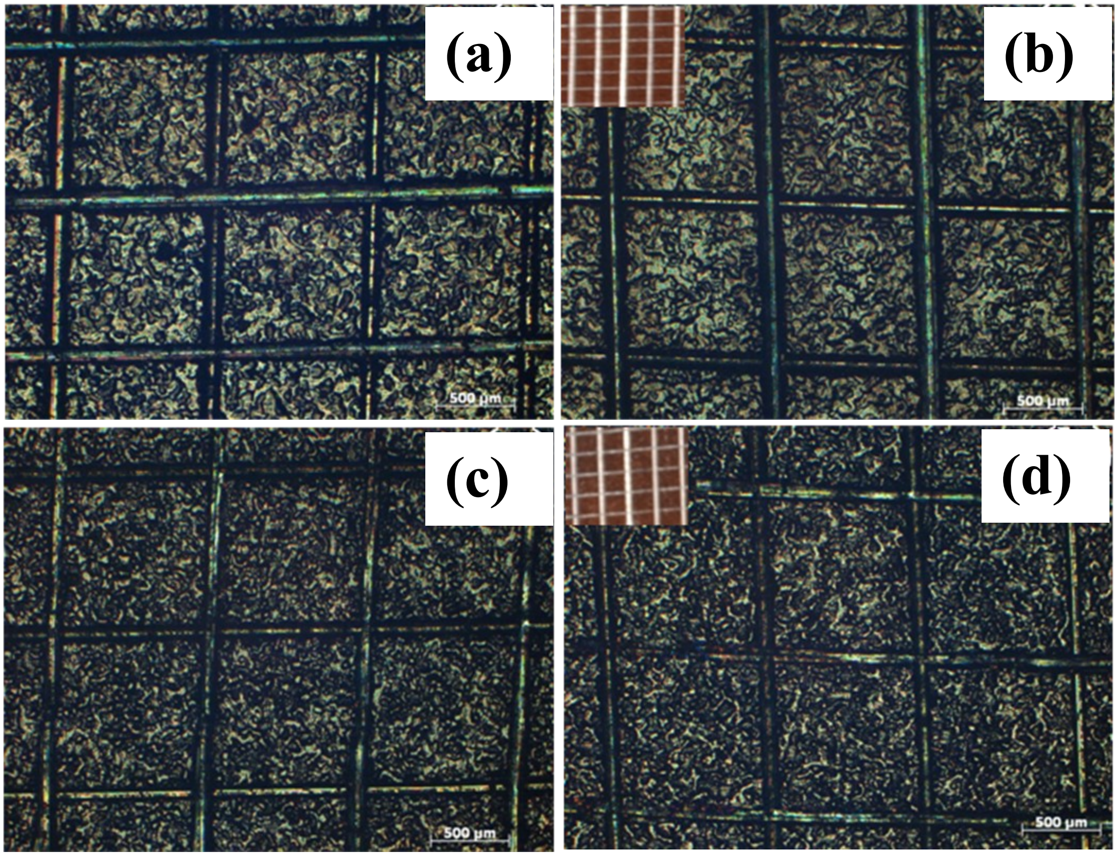

Fig. S7 Represents the optical image of ink coated CR steel; (a) before and (b) after the adhesion test. We have also measured the adhesion test of the oil coated CR steel for comparison; (c) before and (d) after the test. The images clearly show that there is no peeling of the coating indicating the coating has good adherence to the surface of CR steel. The digital photographs of the respective substrate after adhesion test are shown in the inset to (b) & (d). The experiment was carried out as per the ASTM D-3359.

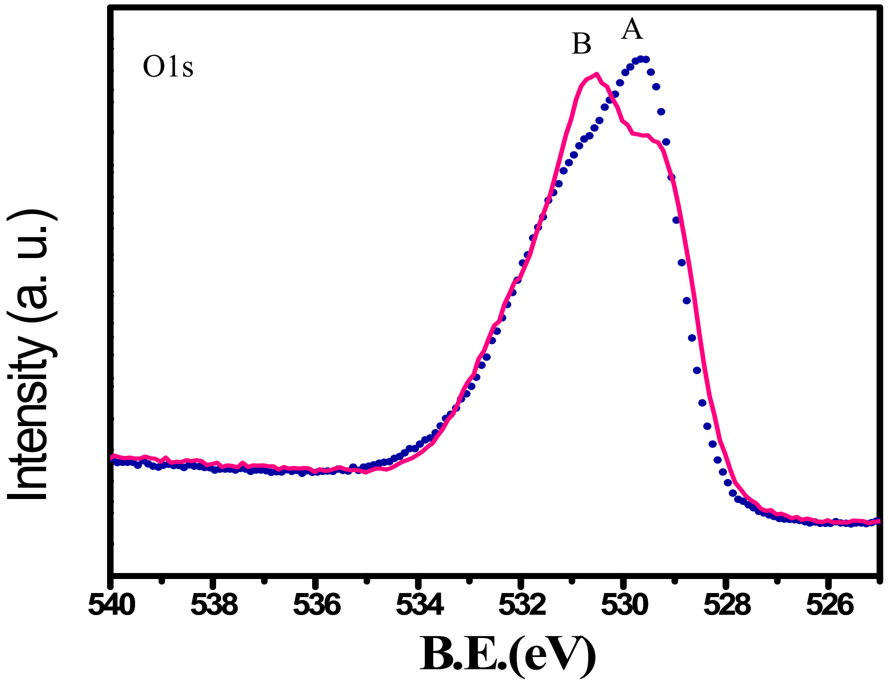

Fig. S8 Shows the O1s XPS spectrum of the polarized (line) and unpolarized (symbol) bare CR steel substrate. The broad peak contains the peaks pertaining to the lattice oxygen (A) and hydroxyl groups (B). The data of polarized substrate show that the intensity of B peak is more intense than the A peak, indicating the generated OH^- ions during the electrochemical test are attached on its surface.

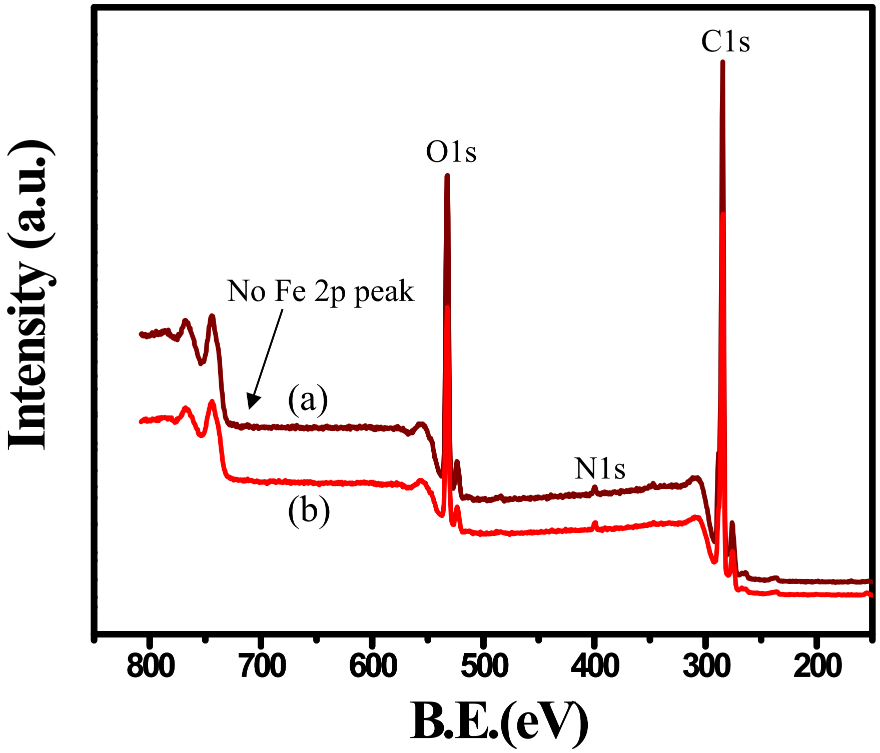

Fig. S9 XPS spectrum of the oil (a) and ink coated (b) CR steel. The spectrum does not show the signature of Fe2p peak, indicating the underneath steel surface is covered fully by the coating material.

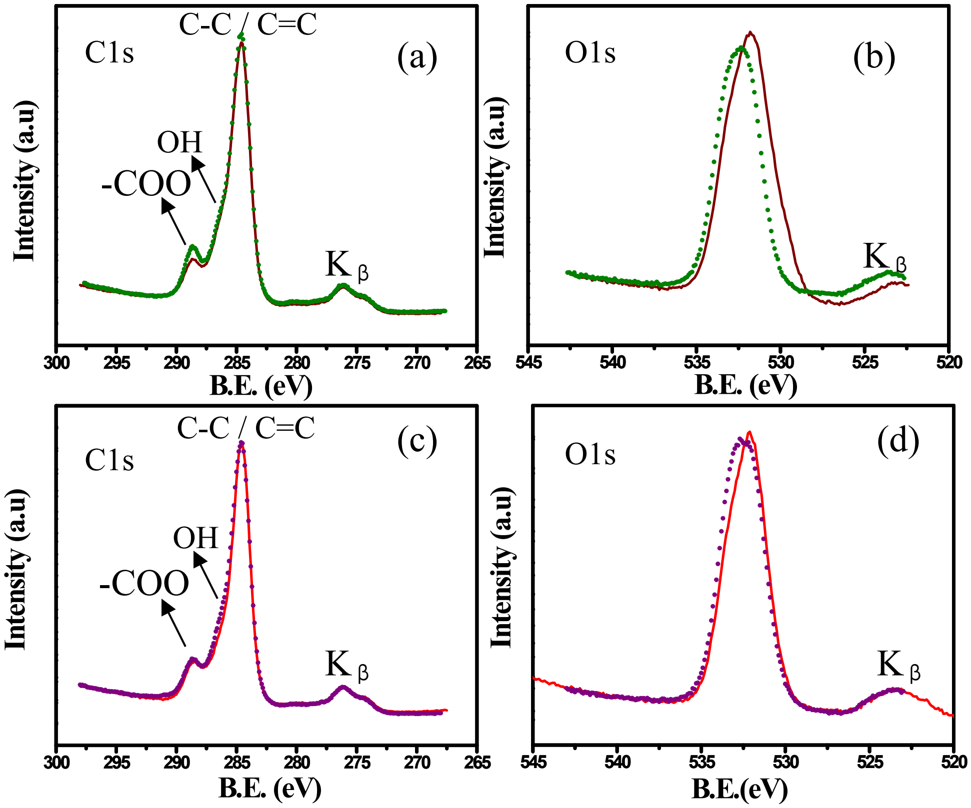

Fig. S10 Shows the XPS spectrum of the oil coated (a & b) and ink coated (c & d) CR steel before (symbol) and after (line) polarization test. The C1s spectrum shows the presence of COO and phenolic OH functional groups. It is noted that the position of the C1s peak is unaltered in both the oil and ink coated CR steel. Whereas, the shifting in the position of the O1s peak towards lower binding energy is observed in the case of oil coated CR steel and a very marginal change in the position is seen in ink coated CR steel after polarization. This shifting is due to the formed Fe_2O_3 and the oxygen functional groups of the oil coating. As in ink coated CR steel, there is almost no Fe_2O_3 and therefore, no shifting occurs in the O1s spectrum.

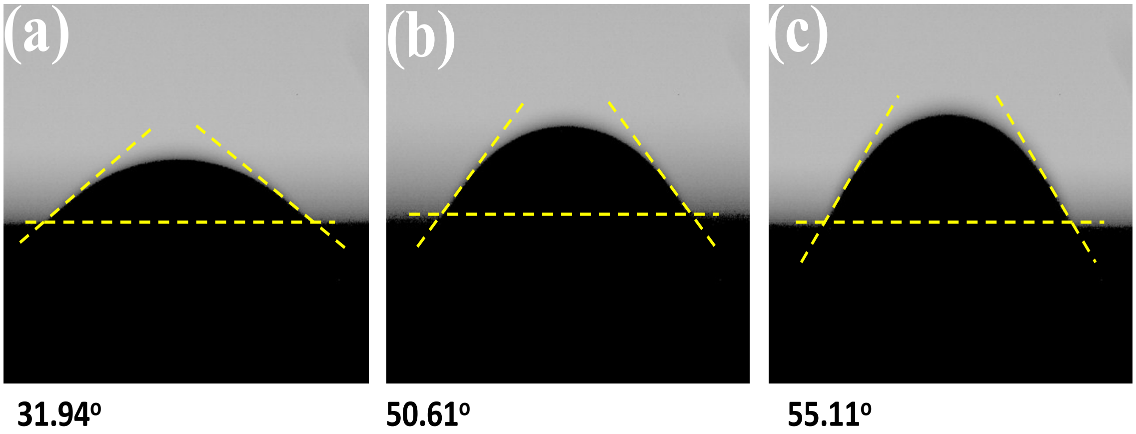

Fig. S11 Depicts the digital image of the water drop on the CR steel substrates in the contact angle measurement test; (a) bare, (b) oil coated and (c) ink coated.