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# Influence of Strain on the Corrosion Behavior of Dual Phase 590 Steel

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**Abstract :** With increasing the demand for safety and fuel efficiency of automobiles, automotive manufacturers are looking for light weight, high strength steel with excellent formability and corrosion resistance. Dual-phase steel is finding applications in automotive sectors, because of its high strength, good formability, and high corrosion resistance. During service automotive components suffer from environmental attack and thereby gradual degradation of the components occurs reducing the service life of the components. The objective of the present investigation is to assess the effect of deformation on corrosion behaviour of DP590 grade dual phase steel which is used in automotive industries. The material was received from TATA Steel Jamshedpur, India in the form of 1 mm thick sheet. Tensile properties of the steel at strain rate of 10-3 sec-1: 0.2 % Yield Stress is 382 MPa, Ultimate Tensile Strength is 629 MPa, Uniform Strain is 16.30% and Ductility is 29%. Rectangular strips of 100x10x1 mm were machined keeping the long axis of the strips parallel to rolling direction of the sheet. These strips were longitudinally deformed at a strain rate at 10-3 sec-1 to a different percentage of strain, e.g. 2.5, 5, 7.5,10 and 12.5%, and then slowly unloaded. Small specimens were extracted from the mid region of the unclamped portion of these deformed strips. These small specimens were metallographic polished, and corrosion behaviour has been studied by potentiodynamic polarization, electrochemical impedance spectra, and cyclic polarization and potentiostatic tests. Present results show that among three different environments, the 3.5 pct NaCl solution is most aggressive in case of DP 590 dual-phase steel. It is observed that with the increase in the amount of deformation, corrosion rate increases. With deformation, the stored energy increases and leads to enhanced corrosion rate. Cyclic polarization results revealed highly deformed specimen are more prone to pitting corrosion as compared to the condition when amount of deformation is less. It is also observed that stability of the passive layer decreases with the amount of deformation. With the increase of deformation, current density increases in a passive zone and passive zone is also decreased. From Electrochemical impedance spectroscopy study it is found that with increasing amount of deformation polarization resistance (Rp) decreases. EBSD results showed that average geometrically necessary dislocation density increases with increasing strain which in term increased galvanic corrosion as dislocation areas act as the less noble metal.

**Keywords :** dual phase 590 steel, prestrain, potentiodynamic polarization, cyclic polarization, electrochemical impedance spectra
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