

## Effect of GI / GA coating on the hydrogen embrittlement of 1180MPa grade steel

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**Abstract** The hydrogen embrittlement of 1180MPa ultra-High Strength steel with GI coating and GA coating for automotive has been studied by electrochemical stripping, electrochemical hydrogen charging, slow tensile test and TDS analysis. The electrochemical stripping test is taken in 3.4 M NaCl + 0.3 M ZnSO<sub>4</sub> solution, and the GI-coated steel shows two plateau potential regions, which respectively corresponding to Zn phase and substrate, while the GA-coated steel shows four plateau potential regions, which attributed to the exposure to  $\zeta$  phase,  $\delta$  phase,  $\Gamma$  phase, and substrate, respectively. At the same time, the decomposition force of GI-coated steel is lower than that of all phases of GA-coated steel, indicating that the impedance of GI coating is greater than that of all phases of GA. After removing the coating, the hydrogen diffusion coefficients of GI1180 and GA1180 are  $8.92 \times 10^{-7} \text{ cm}^2/\text{s}$  and  $8.6 \times 10^{-7} \text{ cm}^2/\text{s}$ , respectively, which are basically equivalent. Under slow strain rate stretching at a hydrogen charging current density of  $4 \text{ mA}/\text{cm}^2$ , the strength losses of GI1180 and GA1180 were 6.87% and 1.95%, respectively. After the slow tensile test, TDS was used to detect the hydrogen content at the fracture site, and the hydrogen content of GI1180 and GA1180 was 0.89 ppm and 1.1 ppm, respectively. This indicates that the GA coating has a more significant effect on hindering hydrogen diffusion, and both steel grades have good resistance to hydrogen embrittlement.

**Keywords** GI/GA coating, Hydrogen diffusion, hydrogen embrittlement sensitivity

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