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Development of Structural Adhesive with High Corrosion Resistance

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Aiming to realize a carbon-neutral society, further weight reduction is required to reduce CO_2 emissions from automobiles. Keeping up with this social responsibility, it is also important to improve driving stability, ride quality, and quietness in order to increase product competitiveness. As one of these solutions, we are developing adhesive joining technology to control rigidity and damping of vehicle body structure. Regarding to damping property, we have greatly improved ride comfort and quietness by applying a damping-adhesive with high loss-tangent and a damping-node-structure that can effectively dissipating vibration energy. However, the both adhesive joining for rigidity and for damping did not apply to portions in severe water condition such as underbody because of corrosion risk. Adhesive defects occur due to fluctuations of plate gap, heat and humidity in uncured state during vehicle body manufacturing process. Fluctuations in plate gap can occur in multiple processes such as stamped part assembly, resistance spot welding, and painting. During the heat curing process in electrodeposition drying furnace, “crevasse defect” may occur at the boundary of adhesion fillet and plate edge on the lap joint (Fig.1). In the case of hot-dip galvannealed (GA) steel, the end face of the steel sheet without GA plating can be a starting point of corrosion since its protection is significantly reduced by the crevasse defect. Then, corrosion can propagate to the adhesion-interface and end up to impair joint function. Therefore, we researched on the suppression of adhesion defects using the corrosion incubation-period L and propagation-speed θ as evaluation indexes with referring to a model-based research on rust of coating films

In this presentation, we report the developed results of a one-component thermosetting epoxy-based structural-adhesive for vehicle-body-rigidity with high-corrosion-resistance based on the elucidated mechanism[1,2)] of crevasse defect formation.

①The higher occurrence of crevasse defect leads to the shorter corrosion-incubation-period L and to the faster-corrosion-propagation-speed θ.

②Materially the main causes of crevasse defects are the high storage-modulus during heating and the volume-increase due to hygroscopic bubbling during heating.

③We developed a formulation in order to optimization of the minimum complex-viscosity during heating ,and to suppression of the hygroscopic which causes bubbling at 100℃.

④We confirmed the excellent corrosion resistance with respect to the joint of GA-steels(Fig.2) and to the joint of aluminum-die-cast and GA-steel. Consequently We also confirmed the excellent performance of retained lap shear strength after exposure under saturated vapor pressure at 70 degrees of Centigrade(Fig.3).

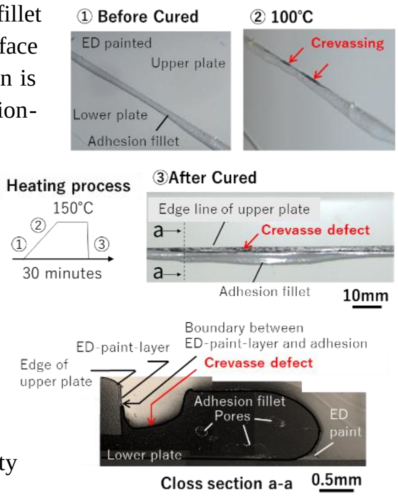

Fig.1 Crevasse defect at adhesion fillet [(1)]

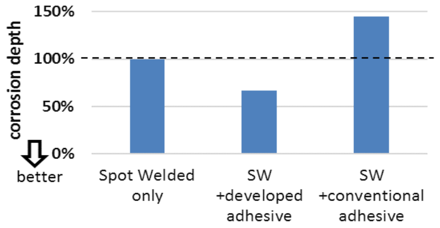

Fig.2 Corrosion depth of lap-joint of GA steel plates under Cyclic Corrosion Test

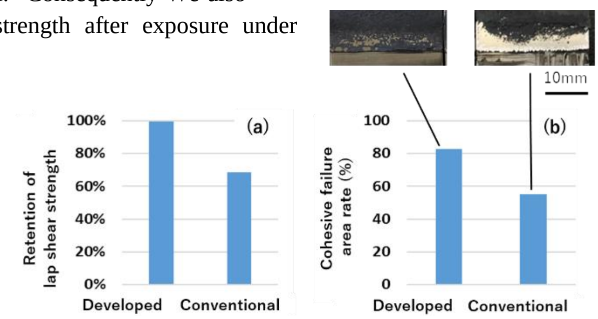

Fig.3 Lap shear strength retention and cohesive failure area rate after exposure at 70℃, saturated vapor pressure, 3 weeks

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