講演番号 338 文献番号 20225338

Verification of the Effect of Tire and Suspension Deformation on Power Transmission to the Coil Mounting Position for Dynamic Wireless Power Transfer

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KEY WORDS: **EV and HV systems, charge/discharge, system technology,** dynamic wireless power transfer [A3]

The mileage per charge for battery electric vehicles (BEV) is the most important issue to increase widely spread. In order to solve this problem, the dynamic wireless power transfer (DWPT) systems are paid attentions. The DWPT systems which feeds the electric power required for the BEV to run while driving, the power consumption of battery is eliminated, and the mileage per charge is able to extend.

In the DWPT, two types of coil mounting locations are proposed: the on-board coil (OBC) method, which is mounted on the chassis of the vehicle as shown in Fig. 1(a), and the wheel-side coil (WSC) method, which is mounted in the upright or wheel of the vehicle as shown in Fig. 1(b) and Fig. 1(c). In addition, the WSC system has been proposed as either an outside wheel coil (OWC), in which the coil is mounted near the wheel via a stay in the upright part of the vehicle, or an in-wheel coil (IWC), in which the coil is placed inside the wheel, although a wheel made of the high-strength plastic material such as CFRP and the organic belt tire is required. In particular, the IWC method reduces the possibility of metallic foreign objects intervening between the road surface and the tire because the tire can remove the foreign objects on the coil during driving, and the effect of the foreign objects on the power transmission can be minimized. The height from the ground to the vehicle changes due to the deformation of the tires and the expansion and contraction of the suspension caused by changes in the number of passengers, acceleration and deceleration during driving, and unevenness of the road surface. This height change is equal to the change of the coil gap in the DWPT. Therefore, the gap variation is directly related to the amount of the power transmission and power supply efficiency, so it should be small. In terms of the coil mounting position, the OBC system is affected by tire deformation and suspension expansion and contraction, while the WSC system is mounted under the spring and only tire deformation occurs.

Fig. 2 shows the results measuring the coils gap variation using the actual vehicle. The coil gap variation of the OWC and IWC ones is smaller than the OBC since the OWC and the IWC are non affected by the suspension deformation. Fig.3 shows the power variation ratio using the measured coils gap changes. A total of six combinations of two types of ground coils and three types of the receiving coils were evaluated. It can be confirmed that the change rate of the OWC and IWC methods is lower than that of the OBC method. From the above results, it is confirmed that the WSC method has a smaller change in the gap between coils and a smalle r power change than the OBC method.

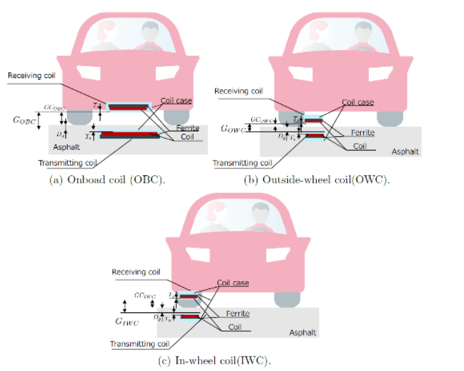

Fig. 1 Comparison of coil mounting positions.

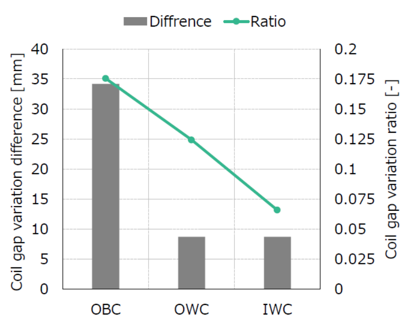

Fig. 2 Coil gap variation.

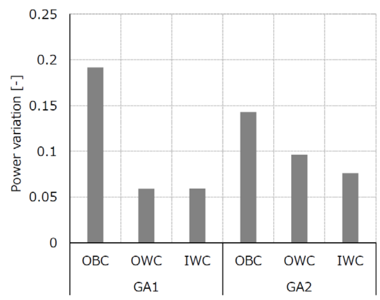

Fig. 3 Experimental results of power variation ratio.