Structure of the Hall magnetic field in dayside magnetic reconnection inferred from MMS data

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Magnetic reconnection is one of the most important processes for understanding the interaction of the solar wind with Earth's magnetosphere. In the Earth's magnetosphere magnetic reconnection can occur at the dayside magnetopause and magnetotail. It is known that the asymmetric reconnection tends to occur at the dayside magnetopause because of the properties of the magnetospheric and solar wind plasmas. In previous simulations of asymmetric reconnection, the bipolar pattern of the Hall magnetic field is suggested. The observations by Magnetospheric Multiscale (MMS) mission have revealed that there is quadrupolar pattern of the Hall magnetic field in the dayside asymmetric reconnection.In this study, we analyze several reconnection events to improve our understanding the Hall reconnection pattern by using MMS data. In addition, we focus on current system to confirm the relationship between the Hall current and the Hall magnetic field in each pattern. We find both quadrupolar and bipolar patterns. In the quadrupolar pattern, the Hall magnetic field has two peaks in the ion diffusion region. On the other hand, in the bipolar pattern, the Hall magnetic field has one peak. We also confirm that the Hall currents generated by ion and electron flows produce the Hall magnetic field.Furthermore, we reveal that the Hall magnetic field of bipolar pattern can be classified as two types. In each type, the position where the Hall magnetic field peaks and the Hall current reverses is different. In first type, the position is between electron inflow region in the magnetospheric side and electron outflow region. In second type, the position is between electron outflow region and electron inflow region in the magnetosheath side or inside the electron outflow region.From this result, we consider that asymmetric properties influence not only the contribution of inflow in the magnetospheric side to the Hall current but also the variety of electron flows in the ion diffusion region.