Hall MHD reconnection with an initial guide field B_{y0}

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An uniform out-of-plane magnetic field component B_{y0} is added to the equilibrium Harris sheet with plasma β=0.5 and L_c=0.5d_i (where L_c is the half-width of the equilibrium current layer and d_i is the ion inertial length). Driven by a constant boundary inflow, the magnetic reconnections with various guide field B_{y0} are investigated using a 2.5 dimensional Hall MHD code developed from a multi-step implicit scheme.

For the cases of B_{y0}/ B_{x0}= 0.0, 0.5, 1.0 and 1.5, the reconnection rates ∂A/∂t$|_{st}$ at quasi-steady states are approximate to 0.15, 0.14, 0.12 and 0.1, respectively. Such results prove that the dynamic growth of Hall MHD reconnection is considerably suppressed by the field of cross-current sheet. In the case with a finite B_{y0} the spatial profile of B_y component along x at z=0.04d_i is a up-down distorted signature with respect to B_y = B_{y0} which is different from the bipolar signature associated with the B_y quadrupolar pattern in the case of a zero guide field (B_{y0}=0).

For the case with a finite B_{y0} the decoupling of electrons and ions also occurs near the X line, but the effect of initial B_{y0} on the electron flow is greater than that on the ion flow. While the ion flow remains primarily horizontal out of the reconnection region, the electrons have a stronger flow into the reconnection region in the first and third quadrants than that in the second and fourth quadrants.