強磁場下での液体金属の対流におけるハートマン境界層による減速の影響
Influence of side-wall Hartmann braking in a liquid metal convection under a horizontal magnetic field

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The effect of magnetic field is important for flows occurring in liquid metals. For phenomena confined by solid boundaries, the existence of side wall is also essential. We performed both laboratory experiments and numerical simulations on Rayleigh-Benard convection with a liquid metal as the test fluid under a strong horizontal magnetic field to elucidate influence of side-wall Hartmann braking on the phenomena. Vessels with different length in the direction of magnetic field were examined to modify the influence. In the laboratory experiments, horizontal velocity profiles were measured by ultrasonic velocity profiler to observe behavior of the convection and to quantify it. It was confirmed that there are quasi-two-dimensional rolls aligned parallel to the magnetic field because of sufficiently strong magnetic field and the magnitude of convection was characterized as variation of Reynolds number with respect to Chandrasekhar number, which is the ration of Lorenz force to the viscous damping. Scaling law describing the variation was derived with assumption of balance between buoyancy given by vertical temperature difference and side-wall Hartmann braking, which is viscous dissipation due to thinning of side-wall boundary layer perpendicular to the magnetic field (Hartmann layer) by the Lorentz force. It is expected that as the length scale in the magnetic field becomes narrower, the influence of Hartmann braking becomes stronger. The variations for different Rayleigh number and the length scale were collapsed into a unified curve by normalization according to the scaling law at conditions of relatively strong magnetic field.

キーワード：磁気対流、境界層、ロール構造
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