Investigation of flow structure in electromagnetically driven liquid metal confined in an annulus by Ultrasonic Doppler Velocimetry

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ABSTRACT

Electromagnetic driving of the fluids as the driving mechanism in electromagnetic pumps is of great interest in industry. On the other hand the fluid flow in annulus has its own place in investigating the channel flow structure in the sense that we can use it as a model for a very long channel. It means that we can have the same flow structure in a confined area without wasting too much energy and effort to build up a long channel. Although the combination of electromagnetic force with toroidal geometry sounds efficient and practical, but lots of questions will arise when we do combine them. These questions are mainly about the formation of Hartmann layer and its role on transition to turbulence. During the last decades several numerical and experimental investigations were aimed to determine the instability criteria of this problem. In the previous experiments the potential drop across the annular channel has been used as a measure to show the transition to turbulence. Since these voltage drops can't give us any information about the structure of the flow, we decided to spot the possibility of using UDV to detect this structure. A rectangular channel with $10\mathrm{mm} \times 67\mathrm{mm}$ cross section and an inner radious of $40\mathrm{mm}$ is used in this investigation. The channel is filled up with eutectic alloy GaInSn. Two insulating Hartmann walls and two conducting side walls which are $10\mathrm{mm}$ apart (in the radial direction) are the special boundary conditions in our case. Side walls are parallel to the magneitc field. Our facilities let us test $500\mathrm{mT}$ as maximum magnetic field and $2000\mathrm{A}$ as the maximum driving current. An ultrasounic 8 MHz sensor with the aid of DOP2000 is used for this investigation.Here we will reperesnts the results of our experiments and compare them with the theoretical predictions of the reference literatures. This will help understanding the role of Hartman layer on transition to turbulence.

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