Measurement of T-dependent electrical resistivity of solid and liquid Fe and Pt at fixed P

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Knowledge of the thermal and electrical conductivity of solid and liquid Fe and its relevant alloys at P and T conditions is essential for understanding the cooling history of planetary cores and modelling their dynamo. The general understanding of the electrical transport properties of the transition metals at lower P will perhaps give insight in understanding Fe behavior at the inaccessible planetary core conditions. Theoretical investigation has suggested that the electrical and thermal conductivity of solid and liquid Fe at Earth’ s core conditions are similar in value (Wagle and Steinle-Neumann, (2017). At ambient T, experimental investigation showed that hcp ε -phase of Fe becomes paramagnetic at ~18GPa while Pt is paramagnetic and crystalize fcc at ambient conditions. Since Fe and Pt have an unfilled *d*-band electronic structure and at high P both exhibits closed packed crystal structures, experimental determination of the transport properties of molten Pt at lower P conditions is important for understanding the behavior of molten Fe preceding ε -phase at ~80 GPa. We develop a technique and cell design for the investigation of the electrical resistivity of metals that keeps it free from contamination using multianvil press. And, we report measurements on Fe and Pt. The sample was kept pure by making the electrodes and the sample the same composition while the thermocouple (TC) is placed close to the sample and taking through the gasket. The major challenge of TC breakage during compression and/or heating was overcome by shielding the TC with a cylindrical hollow coiling ring made of the same composition as the TC leads. The use of current polarity reversal to eliminate biased voltage as deployed in previous studies was adopted. On Fe and Pt, resistivity increases and decreases with T and P respectively, was observed. On melting, Fe result at 3 GPa agrees with very recent data by Silber et al. (2018) which showed an increasing difference in the resistivity value of solid and liquid with increasing P. While, Pt resistivity at 3 GPa appears constant comparable to its 1 atm value.

Keywords: Electrical resistivity, Thermal Conductivity, Iron Fe

