World Academy of Science, Engineering and Technology
International Journal of Physical and Mathematical Sciences
Vol:14, No:07, 2020

Electrical Resistivity of Solid and Liquid Pt: Insight into Electrical Resistivity of ε-Fe

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Abstract : Knowledge of the transport properties of Fe and its alloys at extreme high pressure (P), temperature (T) conditions are essential for understanding the generation and sustainability of the magnetic field of the rocky planets with a metallic core. Since Pt, an unfilled d-band late transition metal with an electronic structure of $Xe4f^{14}5d^{9}6s^{1}$, is paramagnetic and remains close-packed structure at ambient conditions and high P-T, it is expected that its transport properties at these conditions would be similar to those of ε-Fe. We investigated the T-dependent electrical resistivity of solid and liquid Pt up to 8 GPa and found it constant along its melting curve both on the liquid and solid sides in agreement with theoretical prediction and experimental results estimated from thermal conductivity measurements. Our results suggest that the T-dependent resistivity of ε-Fe is linear and would not saturate at high P, T conditions. This, in turn, suggests that the thermal conductivity of liquid Fe at Earth's core conditions may not be as high as previously suggested by models employing saturation resistivity. Hence, thermal convection could have powered the geodynamo before the birth of the inner core. The electrical resistivity and thermal conductivity on the liquid and solid sides of the inner core boundary of the Earth would be significantly different in values.

Keywords : electrical resistivity, thermal conductivity, transport properties, geodynamo and geomagnetic field
Conference Title : ICCMPPT 2020 : International Conference on Condensed Matter Physics and Phase Transition
Conference Location : London, United Kingdom
Conference Dates : July 23-24, 2020