Magnetic Characterisation of Steels at High Temperatures Using Epstein Frame

John William Wilson[1], Lei Zhou[2], Claire Davis[2], Anthony Peyton[3]

[1]Electrical and Electronic Engineering, University of Manchester, United Kingdom, [1]WMG, University of Warwick, United Kingdom, [1]Department of Electrical & Electronic Engineering, University of Manchester, United Kingdom

In steel strip manufacture, mechanical properties are largely defined by the microstructure, which is controlled by the processing conditions and can be predicted using mill models, supported by pyrometer measurements for temperature. In general this works well but inaccuracies can arise for some steel grades. Recent advances to combat this problem include the introduction of electromagnetic sensors for real-time inline measurement of steel phase transformation during cooling after hot rolling. However, in order to fully exploit this technique, it is necessary to fully understand the magnetic (BH) characteristics of steels at high temperatures. This paper details the construction and testing of a measurement system designed to determine the magnetic properties of steels at temperatures up to the Curie point. The apparatus is based on an Epstein frame configuration, is constructed from materials which can withstand temperatures up to 800 degrees and is installed in a furnace fed with argon gas to prevent oxidation of the samples. Materials including silicon steel, ferritic stainless steel and dual phase steel have been tested, with full BH loops measured and loop parameters (magnetic saturation, coercivity) extracted during heating and cooling. The development of this test system is an important step towards full understanding of the dependence of magnetic parameters on material microstructure. These techniques will feed into the further development of electromagnetic techniques for the monitoring of steel strip manufacture.