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Design and experiment of the conduction cooled superconducting magnet for crystal growth application

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In the magnetic Czochralski crystal growth (MCZ) process, a Lorentz force that influences the flow and tends to reduce the amplitude of the melt fluctuations by applying a magnetic field outside the furnace body. It is a main method to suppress the uneven distribution of impurities and reduce the density of crystal defects. The strong magnetic field provided by superconducting magnet is a feasible way to prepare larger than 12-inch semiconductor grade monocrystalline silicon wafer. In this paper, the electromagnetic structure of MCZ superconducting magnet with four-solenoid type is designed. In the cylindrical space region of 800 mm in diameter and 400 mm in height, the magnetic field intensity reaches 0.4 T, the magnetic field inhomogeneity is about ±18%. The superconducting magnet is cooled by conduction cooling mode using GM type refrigerators. By optimizing the low temperature structure of superconducting magnet, the magnet cooling down duration is estimated about 10 days. The magnet is subjected to cooling-down and energizing experiments. The performance of the magnet meets the design requirements.

Key words: superconducting magnet; conduction cooling; crystal growth; MCZ

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