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Magnetron Sputtering of suitable sensitive materials for Hall sensors

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The all commonly used Hall sensors in industry are based on semiconductors which are inconvenient for devices operating in a hard environment with radiation and high temperatures. In such environment the ceramic-metal Hall sensors with high temperature and radiation resistance have to be used. The metal Hall sensors consist of a thin film of suitable metal deposited on a ceramic substrate. The DC magnetron sputtering was used for the preparation of series of thin film sensors based on various metals. During depositions there was a necessity to find proper combination of parameters such as the power of DC source, i.e. deposition rate, substrate temperature, deposition time, which corresponds to the thickness of thin film, and an appropriate positioning of substrates in the deposition chamber. All these parameters have significant influence on final properties of the thin film Hall sensor. The research was focused on the optimization of deposition parameters and determination of production processes leading to improve sensor functionality. The research and development of thin sensitive layers made from bismuth resulted in the implementation of a new magnetic diagnostics for the international fusion reactor ITER. The outer vessel steady-state magnetic field sensors based on bismuth thin films will perform an absolute measurements of the ITER magnetic field. The Hall sensors with bismuth thin film were deposited on ceramic aluminum nitride AlN substrates at the deposition temperature of 200°C. The steady-state magnetic sensors will also be an important part of diagnostics for the future fusion power reactors starting with the DEMO device. The higher ambient temperature at some sensor locations in DEMO compared to ITER limits the applicability of bismuth sensors and, therefore, several candidate materials like antimony, molybdenum, tantalum, and niobium, offering higher operational temperatures compared to bismuth are the subject of the present research.

Keywords
magnetron sputtering
thin film
hall sensor