O-21-3

Magnetic Diagnostics in Extreme Temperature Conditions

Semir El-Ahmar [1,*], Jakub Jankowski [1], Paweł Czaja [1], Wiktoria Reddig [1], Marta Przychodnia [1], Jan Raczyński [1], Wojciech Koczorowski [1]

[1] *Institute of Physics, Poznan University of Technology, 61-138 Poznan, Poland*
[*] presenting author email: semir.ahmar@gmail.com

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Topic 3
Magnetic sensors

Magnetic field detection devices are highly valuable in many industries, thanks to the fact that they can measure various quantities such as position, movement, direction, and rotational speed. Nowadays, there is a high demand for electronics that can function reliably in harsh environments, including those that can withstand extreme temperatures. Traditional electronics design often requires active or passive cooling, but this may not always be practical or effective. Hence, there is an increasing need for extreme environment electronics, particularly in the automotive, space, defense, and energy industries. [1].

Our latest reports on semiconductor-based Hall sensors operating in extreme conditions are limited to the temperature range from liquid nitrogen (LN) up to 350 °C [2]. Research on alternative solutions based on monolayer graphene, in turn, presents tests in the LN - 500 °C range in a magnetic field below 1 T [3]. Our research explores the potential of utilizing classic semiconductor thin-film material (donor-doped indium antimonide) as an active layer for a Hall effect sensor that can measure magnetic fields in extreme temperature range from liquid helium (LHe) temperatures up to 350 °C. We verify the usability, thermal stability of our device, and the linearity of its signal in the magnetic field range above 1T. We also propose a solution to the problem of the sensor package suitable for an extremely wide range of work. We present a full-fledged magnetic field sensor that can meet industrial requirements, being manufactured using almost exclusively the academic infrastructure of the Poznan University of Technology. Our finding is a step forward in the development of magnetic diagnostic devices capable of operating in a broadly defined extreme environment.

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References

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