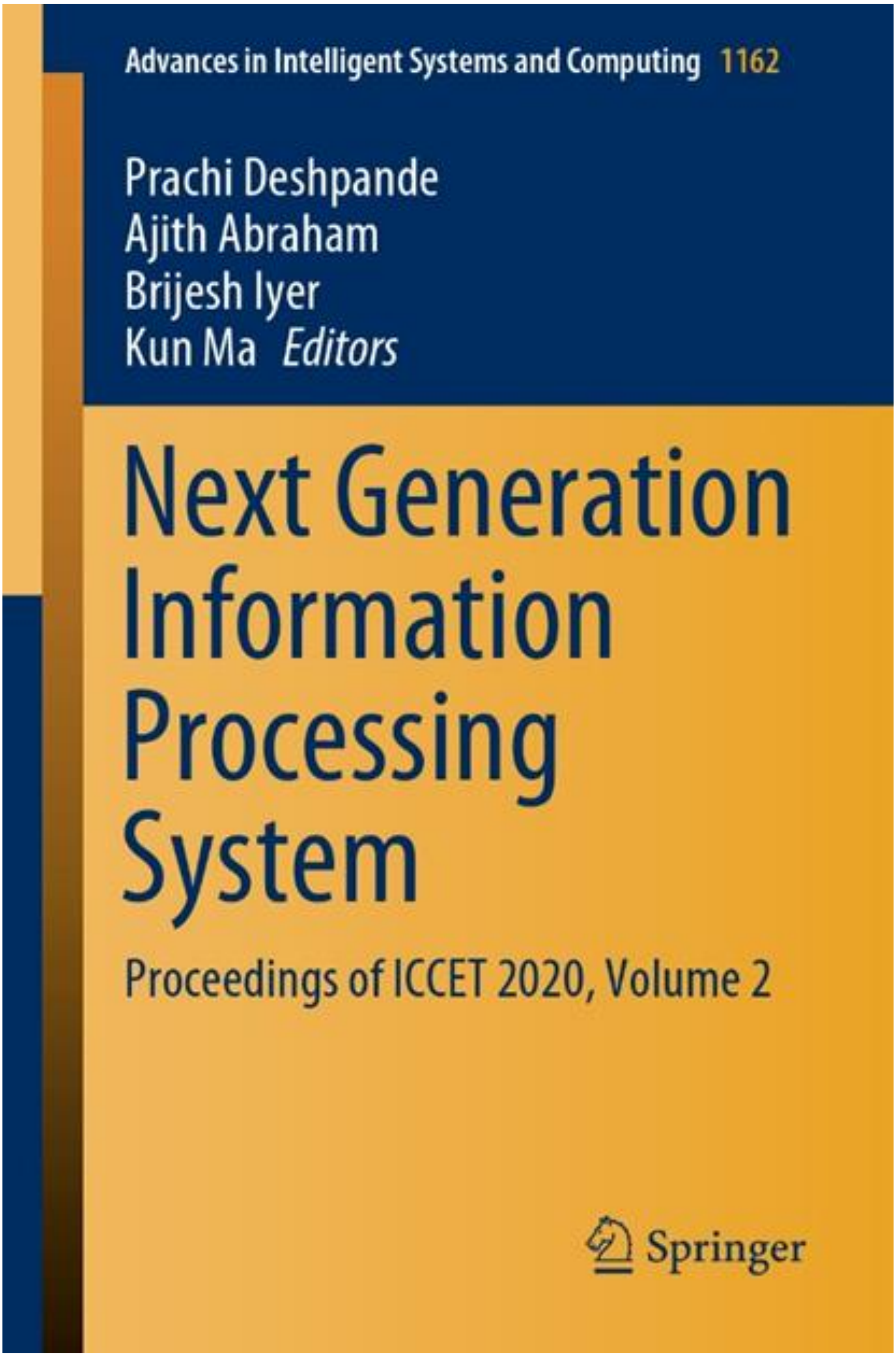
Dr. K.R. Nemade: Performance Study Of Spin Field-Effect Transistor Based On Cobalt-Modified Iron Oxide Ferromagnetic Electrode



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ISSN 2194-5357 ISSN 2194-5365 (electronic)
Advances in Intelligent Systems and Computing
ISBN 978-981-15-4850-5 ISBN 978-981-15-4851-2 (eBook)
https://doi.org/10.1007/978-981-15-4851-2

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The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Performance Study of Spin Field-Effect Transistor Based on Cobalt-Modified Iron Oxide Ferromagnetic Electrode

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Abstract. Spintronics-based field-effect transistors (s-FET) are a new category of devices, which is an improvement over ordinary transistor by adding the properties of magnetoresistance. The conductivity of s-FET can be controlled by the spin degree of freedom of an electron, which results in extremely low power consumption and low heat dissipation. In the present work, a primary attempt is made to analyze the performance of s-FET designed on two-dimensional electron gas substrate. Superconducting quantum interference device (SQUID) is employed to analyze the magnetic properties of ferromagnetic contacts that cobalt-modified iron oxide. The role of spin polarization in the spin transport phenomenon of s-FET is also analyzed. It is proved that for the higher possible value of spin polarization, spin current also increases. For the value of spin polarization ($p = 0.8$), strong enhancement was observed in the spin current. The switching action in s-FET is checked as a function of gate voltage, and it shows a strong dependence on the gate voltage.

Keywords: Spintronics · Field-effect transistor · Two-dimensional electron gas substrate

1 Introduction

Spintronics is the next version of electronics, which utilizes the spin degree of freedom in the device fabrication process for memory, logic and switching applications [1]. In this process, s-FET is the most studied fundamental device by researchers due to its outstanding features like ultralow power consumption and novel logic design. The s-FET first discussed by Datta and Das by experimenting with the external electric field to control the spin orientation of the spin-polarized current in two-dimensional electron gas [2]. Researchers across the globe tried to realize s-FET and recently succeeded in achieving it with feasibility through experimental as well as theoretical approaches [3–6]. The working mechanism of s-FET comprises the modulation of the source to drain

P. Deshpande et al. (eds.), *Next Generation Information Processing System*,
Advances in Intelligent Systems and Computing 1162,
https://doi.org/10.1007/978-981-15-4851-2_10