

INFORMATION ON DOCTORAL THESIS

1. Full name: Le Khac Quynh
2. Sex: Male
3. Date of birth: 01/12/1982
4. Place of birth: Dong Minh Village, Tien Hai District, Thai Binh Province.
5. Admission decision number: 3205/QĐ-SĐH Dated 8th, November, 2010 by the Director of Vietnam National University, Ha Noi.
6. Changes in academic process:
(List the forms of change and corresponding times)
Change of thesis title:
 - Before: Investigation, design, fabrication micro-nano sensor base on magnetostrictive materials and anisotropic magnetoresistance materials.
 - After: Investigation, fabrication of magnetic sensor in Wheatstone bridge of micro-nano size base on anisotropic magnetoresistance effects.
 - Time of change: 26th, March, 2019 by suggestions of the Council.
7. Official thesis title: Investigation, fabrication of magnetic sensor in Wheatstone bridge of micro-nano size base on anisotropic magnetoresistance effects.
8. Major: Nano materials and devices
9. Code: 944012801.QTD
10. Supervisors:
(Full name, academic title and degree)
The first supervisor: Assoc. Prof. Dr. DoThi Huong Giang
The second supervisor: Dr. Tran Mau Danh
11. Summary of the **new findings** of the thesis:
 - Fabricate and investigate the magnetic and anisotropy magnetoresistance properties depending on shape, size, geometry, thickness, strength and direction of pinned magnetic field based on Ta/Ni₈₀Fe₂₀/Ta thin films by using sputtering technique.
 - Simulation, calculation, optimal design which to fabricated magnetic sensors in Wheatstone bridge design with different shape, size, thickness and configuration (single,

in series or in series-parallel) of the resistors for optimizing low-field magnetic sensing. Optimal sensor (with the serial-parallel structure) has not only high sensitivity but also small thermal noise, so it has the high signal to noise ratio.

- Applications in angular sensing with the Earth's magnetic field and DNA detecting by using optimum fabricated sensors:

- For angular sensor applications, by using the sensor consisted of 18 bars in a series-parallel circuit with $10\ \mu\text{m} \times 250\ \mu\text{m}$ in size and 5 nm-thickness, it showed an angular sensitivity of $S_\alpha = 36\ (\mu\text{V}/\text{deg.})$.
- For magnetic particles detection sensor applications, by using the sensor consisted of 6 bars in a series-parallel circuit with $150\ \mu\text{m} \times 3.2\ \text{mm}$ in size and 5 nm-thickness, it showed a detection limit of magnetic moment per sensor area of $194 \times 10^{-15}\ \text{emu}/\mu\text{m}^2$.
- For Biosensor applications, by using the optimal dimension (4mm in length, 0.15 mm in width and 5 nm in thickness), the fabricated sensor could sense with the smallest amount of 4.5 pmol single-stranded target DNA of streptococcus S.suis.

12. Practical applicability, if any:

- For angular sensor applications.
- For magnetic particles detection sensor and biosensor applications.

13. Further research directions, if any: This research will be continued for developing these sensors for a realizable commercial application product.

14. Thesis-related publications:

(List them in chronological order)

[1]. Bui Dinh Tu, Do Thi Huong Giang, Dong Quoc Viet, Nguyen Xuan Toan, Tran Mau Danh, **Le Khac Quynh**, Nguyen Hai Binh, Nguyen Huu Duc (2013), Research, manufacturing sensor measure the low magnetic field structure Wheatstone bridge based on anisotropic magnetoresistance effects (AMR), Collection of the 8th National Conference on Solid Physics and Materials Science, Thai Nguyen, page 25.

[2]. **L.K. Quynh**, B.D. Tu, D.X. Dang, D.Q. Viet, N.H. Duc, L.T. Hien and D.T. Huong Giang (2015), *Fabrication and Investigation of magnetic sensor based on anisotropic magnetoresistance effects for magnetic beads detection*, Collection of the 9th National Conference on Solid Physics and Materials Science (SPMS), Ho Chi Minh City, page 93.

[3]. **L.K. Quynh**, B.D. Tu, D.X. Dang, D.Q. Viet, L.T. Hien, D.T. Huong Giang, N.H. Duc (2016), *Detection of magnetic nanoparticles using simple AMR sensors in Wheatstone bridge*, Journal of Science: Advanced Materials and Devices 1, pp. 98-102.

- [4]. LT Hien, **LK Quynh**, VT Huyen, BD Tu, NT Hien, DM Phuong, PH Nhung, DTH Giang, NH Duc (2016), *DNA-magnetic bead detection using disposable cards and the anisotropic magnetoresistive sensor*, Advances in Natural Sciences: Nanoscience and Nanotechnology, 7, pp. 045006.
- [5]. **L.K. Quynh**, B. D. Tu, C.V. Anh, N. H. Duc, A.T. Phung, T.T. Dung, and D. T. Huong Giang (2018), *Design Optimization of an Anisotropic Magnetoresistance Sensor for Detection of Magnetic Nanoparticles*, Journal of Electronic Materials, 48(2), pp. 997-1004.
- [6]. **Le Khac Quynh**, Nguyen The Hien, Nguyen Hai Binh, Tran Tien Dung, Bui Dinh Tu, Nguyen Huu Duc and Do Thi Huong Giang (2019), *Simple planar Hall effect based sensors for low-magnetic field detection*, Advances in Natural Sciences: Nanoscience and Nanotechnology 10, pp. 025002.
- [7]. **L.K. Quynh**, B.D. Tu, N.T. Thuy, D.Q. Viet, N.H. Duc, A.T. Phung, and D.T. Huong Giang (2019), *Meander anisotropic magnetoresistance bridge geomagnetic sensors*, Journal of Science: Advanced Materials and Devices, 4 (2) pp. 327-332.

This list includes 07 works.