

INFORMATION ON DOCTORAL THESIS

1. Full name: Phan Nguyen Duc Duoc
2. Sex: Male
3. Date of birth: 17/08/1990
4. Place of birth: Thua Thien Hue
5. Admission decision number: 778/QĐ-CTSV Dated 21/08/2017
6. Changes in academic process:
 - + Adjusting supervisors and topic of the doctoral thesis followed the Decision No. 341/QĐ-DT, dated 04/03/2019.
 - + Adjusting the title of the doctoral thesis followed the agreement of the first doctoral thesis evaluation council, dated 11/11/2021.
7. Official thesis title: Synthesis of graphene-carbon nanotubes hybrid materials with Au, Fe₃O₄ nanoparticles applied to biosensors
8. Major: Nano materials and devices
9. Code: 944012801QTD
10. Supervisors:
 - Supervisor 1: Assoc. Prof. Dr. Pham Duc Thang
 - Supervisor 2: Dr. Nguyen Van Chuc
11. Summary of the **new findings** of the thesis:
 - The DWCNTs-Gr hybrid material was fabricated on copper foil by thermal chemical vapor deposition method under a low-pressure ambience. The optimal condition was DWCNTs concentration of 0.3 g/L at a speed of 4000 rpm for 1 min. The obtained material has electrical and electrochemical properties better than Gr under the same condition. The DWCNTs-Gr modified electrode was used to detect As(V) in the 1-10 ppb range with low detection limit of 0.287 ppb.
 - The DWCNTs-AuNPs-Gr hybrid material was successfully fabricated on copper foil by thermal chemical vapor deposition method under a low-pressure ambience. Electrical and electrochemical properties of DWCNTs-AuNPs-Gr have been enhanced more significantly than Gr and DWCNTs-Gr. The optimal volume ratio of DWCNTs (0.3 g/L):AuNPs (0.2 mM) in solution is 1:3. The DWCNTs-AuNPs-Gr modified electrode was used to detect cholesterol in the range of 0.5-12 mM with high sensitivity of 20.7 $\mu\text{A}/\text{mM}\cdot\text{cm}^2$.

- The GO/DWCNTs@Fe₃O₄/Cs hybrid material was successfully fabricated and applied to electrochemical biosensors by assembly method. The GO/DWCNTs@Fe₃O₄/Cs modified electrode has significantly improved electrochemical properties than the bare electrode. The obtained material was used to detect glyphosate in the wide range of 0.1-1000 ppb.

12. Practical applicability, if any: Our fabricated materials have potential applications to electrochemical biosensors for analyzing heavy metal ions and biomedical diagnostics.

13. Further research directions, if any:

14. Thesis-related publications:

1. P.V. Cường, **P.N.D. Duoc**, C.T. Thanh, N.K. Như, L.T.Q. Xuân, P.V. Trinh, Đ.N. Thuận, B.T.P. Thảo, P.Đ. Thắng, N.V. Chúc (2022), Vật liệu tổ hợp graphene-ống nano cacbon-hạt nano vàng: chế tạo và tính chất, *Tạp chí Khoa học Đại học Huế: Khoa học tự nhiên* (Accepted).
2. C.T. Thanh, N.H. Binh, **P.N.D. Duoc**, P.V. Trinh, N.N. Anh, N.V. Tu, N.V. Tuyen, N.V. Quynh, V.T. Thu, V.C. Tu, B.P. Thao, P.D. Thang, H. Abe, N.V. Chuc (2021), “Electrochemical sensor based on reduced graphene oxide/double-walled carbon nanotubes/Fe₃O₄/chitosan composite for glyphosate detection”, *Bulletin of Environmental Contamination and Toxicology*, 106, 1017 (SCIE, Q2, IF: 2,151).
3. **P.N.D. Duoc**, N.H. Binh, T.V. Hau, C.T. Thanh, P.V. Trinh, N.V. Tuyen, N.V. Quynh, N.V. Tu, V.D. Chinh, V.T. Thu, P.D. Thang, P.N. Minh, N.V. Chuc (2020), “A novel electrochemical sensor based on double-walled carbon nanotubes and graphene hybrid thin film for arsenic(V) detection”, *Journal of Hazardous Materials*, 400, 123185 (SCIE, Q1, IF: 10,588).
4. **P.N.D. Duoc**, T.V. Hậu, N.H. Bình, C.T. Thanh, L.Đ. Quang, N.P. Thảo, N.V. Tuyên, N.T. Dung, N.V. Chúc (2018), “Nghiên cứu phát triển và ứng dụng cảm biến sinh học điện hóa trên cơ sở vật liệu tổ hợp ba chiều Gr/CNTs nhằm phát hiện hàm lượng cholesterol”, *Tạp chí phân tích Hóa, Lý và Sinh học*, 4, 65.
5. **P.N.D. Duoc**, N.H. Binh, T.V. Hau, C.T. Thanh, P.V. Trinh, N.V. Tuyen, N.V. Quynh, N.V. Tu, V.D. Chinh, P.N. Minh, N.V. Chuc, Transparent DWCNTs-graphene hybrid film based electrochemical sensor for arsenic (V) detection, *Proceedings of The 9th International Workshop on Advanced Materials Science and Technology - IWAMSN*, 7-11 Nov. 2018, Ninh Binh, Vietnam.
6. **P.N.D. Duoc**, T.V. Hậu, P.V. Trinh, C.T. Thanh, N.V. Tú, Đ.T. An, N.T.H. Vân, N.V. Chúc, Chế tạo màng tổ hợp CNTs/graphene cấu trúc ba chiều bằng phương pháp ủ nhiệt, *Kỷ yếu Hội nghị vật lý chất rắn và khoa học vật liệu lần thứ 10*, 19-21 tháng 10, 2017, Thừa Thiên Huế, Việt Nam, Tr. 444

7. **N.D.D. Phan**, N.D. Nguyen, V.H. Tran, T.T. Nguyen, V.H. Nguyen (2017), “Functional integral method in quantum field theory of Dirac fermions in graphene”, *Adv. Nat. Sci.: Nanosci. Nanotechnol.* 8, 035018. (ESCI).
8. **N.D.D. Phan**, V.H. Tran (2017), “Functional integral method in quantum field theory of plasmons in graphene”, *Adv. Nat. Sci.: Nanosci. Nanotechnol.* 8, 045017. (ESCI).
9. **N.D.D. Phan**, V.H. Tran, V.H. Nguyen, T.T. Nguyen, Functional integral method in quantum field theory of dirac fermions and plasmons in graphene, Proceedings of *The 6th International Workshop on Nanotechnology and Application - IWNA*, 08-11 Nov. 2017, Phan Thiet, Vietnam, pp. 25.
10. T.V. Hậu, **P.N.Đ. Dược**, P.V. Trình, C.T. Thanh, N.V. Tú, N.N. Trác, N.T. Hồng, N.V. Chúc, Chế tạo màng mỏng graphene từ đường Saccarozơ, *Kỷ yếu Hội nghị vật lý chất rắn và khoa học vật liệu lần thứ 10*, 19-21 tháng 10, 2017, Thừa Thiên Huế, Việt Nam, Tr. 440.