Departamento de Química
Universidad de La Laguna

Review of the habilitation thesis

Author (name and surname): Surjyakanta Rana

Author´s affiliation (institution): Department of Functional Materials, Alexander Dubček University of Trenčín, Slovakia

Field of habilitation: *Inorganic Technology and Materials*

Title of habilitation thesis: "Graphene-Based Metal Nanocomposites: Harnessing the Synergy of Graphene and Metal Nanoparticles in Coupling Reactions"

Reviewer (name, surname, titles): professor PedroNúñez

Reviewer´s affiliation (institution): University of La Laguna, Canary Islands, Spain

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Introduction

Dr. Surjyakanta Rana is a researcher at the Department of Functional Materials, Centre for Functional and Surface Functionalized Glass (FunGlass) at the Alexander Dubček University of Trenčín. He is applying for the title of Associate Professor (Docent) in the field of Inorganic Technology and Materials. His habilitation thesis is titled "Graphene-Based Metal Nanocomposites: Harnessing the Synergy of Graphene and Metal Nanoparticles in Coupling Reactions". Dr. Rana earned his Ph.D. in Chemistry from Utkal University, India, in April 2013

Assessment of the pedagogical activities of the candidate

Dr. Rana has demonstrated extensive pedagogical experience exceeding the minimum requirement of three years post-PhD. His primary teaching activities occurred between 2013 and 2017 at the University of KwaZulu-Natal (South Africa), where he taught Physical Chemistry and courses on Research Methodology and Nanomaterials for Honours, Master's, and Ph.D. students.

His mentorship record is significant and international in scope:

- Ph.D. Level: He has mentored four Ph.D. students at the University of KwaZulu-Natal (VHS Bhakaruni, Suryanarayana Maddila, Gracious Shabalala, and Olayinka Ojo). He is currently a co-supervisor for one Ph.D. student (Ebrima Ceesay) at FunGlass in Slovakia.

- Master's and Bachelor's Level: He has co-supervised or mentored five Master's and three Bachelor's students across institutions including the University of Antwerp (Belgium), University of KwaZulu-Natal (South Africa), and Universidad de La Laguna (Spain).
- Other Activities: He served as an external examiner for final-year Pharmacy students in 2016 and has participated in extracurricular scientific cycles like the Kekule lectures

Assessment of the publication activities of the candidate

Dr. Rana's scientific output is robust, significantly exceeding the criteria for the habilitation procedure

- Scientific Papers: He has published a total of 60 scientific and research papers in categories A+, A, A-, or B, with 57 of these appearing in journals registered in WOS or SCOPUS (Category A+/A)
- Citations: His work has received 1,449 citations (excluding self-citations of all authors), yielding an h-index of 25 (Scopus) or 23 (Web of Science)
- Monographs and Projects: He has authored two chapters in scientific monographs published by Springer and IntechOpen. Additionally, he has been involved in 11 grant projects, serving as the main coordinator for several in South Africa, Belgium (Marie Curie Actions), and India
- Professional Service: He is highly active in the scientific community, serving as an Associate Editor for Frontiers in Chemistry and an Editorial Board Member for journals such as Scientific Reports. He has also performed reviewer duties for over 24 international scientific journals

Comments on the structure and the content of the thesis

(The habilitation thesis is written as a commented collection of previously published scholarly papers of the Author)

The core content focuses on the design, fabrication, and characterization of graphene-based metal nanocomposites as advanced heterogeneous catalysts.

- Synthetic Scope: The work details the synthesis of both noble (Pd) and earth-abundant (Ni and Cu) metal nanoparticles supported on reduced graphene oxide (RGO) and amine-functionalized RGO.

- Analytical Rigor: The candidate employed a comprehensive suite of characterization techniques, including XRD, FTIR, Raman, TEM/SAED, SEM, EDS, and XPS, to verify the structural integrity and electronic states of the catalysts.
- Catalytic Efficacy: The research successfully evaluated these materials in industrially critical C–C and C–heteroatom coupling reactions, specifically Mizoroki–Heck, Suzuki–Miyaura, Ullmann, and Kumada–Corriu reactions.
- Annexed Works: The thesis incorporates seven high-impact papers (P1–P7) published between 2015 and 2024, providing a cohesive narrative on harnessing the synergy between graphene and metal nanoparticles

Assessment of the formal side of the work (language, style, structure)

The thesis is written in English and follows a logical, professional structure.

- Structure: It includes clear sections for scientific context, research objectives, a summary of findings (including mechanistic insights), and a Slovakia-language summary (Celkový Súhrn).
- Language and Style: The language is scientifically precise, and the complex characterization data is effectively synthesized into a coherent commentary.
- Originality: An official originality check (AIS) reported a 4.43% overlap, confirming that the work meets high standards of academic integrity while correctly referencing the candidate's own previously published papers.

Reviewer´s questions for discussion to be answered during the thesis defense

Based on the research objectives and findings, the following questions are proposed:

1. How does the amine functionalization on the RGO surface specifically influence the electronic interaction with Pd nanoparticles, and how does this translate to the observed stability against leaching in Mizoroki–Heck reactions?
2. Considering the move toward sustainable chemistry, what are the primary challenges when transitioning from noble metal (Pd) catalysts to earth-abundant metal (Ni, Cu) catalysts for large-scale industrial coupling reactions?
3. In the study of the ternary hybrid system (Cu(0)@Amine-RGO/MCM-41), what is the specific role of the mesoporous silica (MCM-41) in preventing nanoparticle agglomeration compared to the binary RGO systems?

Conclusion (Explicitly expressed proposal for the award of the scientific-pedagogical title of associate professor):

Habilitation thesis of Dr. Rana Surjyakanta titled „Graphene-Based Metal Nanocomposites: Harnessing the Synergy of Graphene and Metal Nanoparticles in Coupling Reactions", fulfils the requirements for the habilitation in the field „Inorganic Technology and Materials ".
I recommend acceptation of the habilitation thesis for the habilitation procedure at the Alexander Dubček University of Trenčín and after its successful defense awarding Dr. Rana Surjyakanta the scientific – pedagogical title of "associate professor" in the field of „Inorganic Technology and Materials ".

Place and Date: La Laguna, Tenerife, Spain,

Reviewer´s Signature