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### Report on Chemistry Research Centre - Vila Real (CQ-VR) 2020 Annual Activity Report

In 2020 the Chemistry Research Centre – Vila Real (CQ-VR) completed 18 years since its foundation in 2002 with significant progress made with important achievements. The number of full researchers in the CQ-VR increased, the number of PhD students increased, the number of patents submitted and granted as well as the number of approved projects from other funding sources besides FCT-Portugal also increased. The number of publications in international peer-reviewed journals has also increased significantly. **In 2020 the CQ-VR has 67 personal members** and was composed of **34 integrated researchers, 4 Post doctorate researchers, 34 PhD students** (the highest value ever attained by the group), **2 Technical and administrative staff and 27 collaborators**. The governance is realized by a **Director** (Dr. Fernando Hermínio Ferreira Milheiro Nunes), **2 Vice-Directors** (Dr. Maria Cristina Fialho Oliveira, and Dr. João Filipe Coutinho Mendes) , **4 Teams researchers** leaders : - **Applied Organic Chemistry** (Dr. Paulo Fernando da Conceição Santos), - **Materials Chemistry** (Dr. Verónica Cortés de Zea Bermudez), - **Environmental Chemistry** (Dr. José Alcides Silvestre Peres), - **Food Chemistry and Biochemistry** (Dr. Maria Fernanda Gil Cosme Martins).

**The CQ-VR is working on several different challenges of the great research topics teams:**

**Applied Organic Chemistry:** Design and synthesis of new functional organic molecules; Cyanine dyes photosensitizers for photodynamic therapy of cancer, fluorescent NIR probes for biomolecules and dye-sensitized solar cells; Calixarene-based architectures and carbon nanomaterials for sensory applications, (photo)catalysis, optoelectronic devices, bioimaging and nanomedicine; Heterocyclic photochromic compounds for application in ophthalmic lens coatings.

**Materials Chemistry :** Development of new functional materials ; Oxide materials for electronics, biosensing and catalysis ; Hydrophilic carbon nanomaterials for sensors, fuel

cells and medical therapies., Nanocatalysts and membrane electrode assemblies for (micro)fuel cells ; Modified carbon-based electrodes for health applications ; Organic/inorganic (bio)hybrid materials for smart windows, solar concentrators, batteries, fuel cells, optics, biomedicine, an (super)hydrophobic paintings/coatings ; Alkali-activated composites for the construction industry

**Environmental Chemistry** : Application of advanced oxidation processes for water and wastewater treatment: removal of contaminants of emerging concern and microorganism inactivation ; Development of new eco-efficient solutions for the management of agro-industrial by-products and the environmental modeling of multiple-use watersheds focused on the interplay between anthropogenic pressures and stream water contamination, as well as of catchments affected by natural or man-induced disasters, are also major goals ; Study of the microbial and biochemistry activity of the soil related to global warming, nutrient cycling and energy effort for nutrient acquisition.

**Food Chemistry & Biochemistry** : New food formulations, innovative technologies, and processes to improve the production, safety and quality of wine and foods ; Improvement and development of new analytical methods for wine and food safety and quality control; Chemical and toxicological characterization of food bioactive compounds ; Biochemical, chemical, and sensory modifications during production, processing and conservation to contribute to a healthier diet ; Development of functional foods with innovative properties devoid of allergenicity ; Evaluation of the bioactive compounds impact on diseases and aging.

A very important achievement in 2020 was **the number of projects in which the CQ-VR members participated as Principal Investigator or part of the research team.**

**The group managed 49 research projects.** And we will underline that Eighteen **(18) new projects were approved in 2020, with 5 international and 13 national projects. 22 projects are still running and further 8 projects were finished in 2020. One national patent was granted, and seven (7) patents were submitted, 3 European and 4 National patents. This numbers show the great dynamism and efficiency of the CQVR researchers' group.**

It should be also notice that one Junior Investigator contract and one PhD scholarship were attributed to the CQ-VR in the National Competitive Call of 2020 (FCT-Portugal). **In 2020 the number of PhD thesis and Master Dissertations concluded that involved the supervision or co-supervision of COVR members was 4 (highest number to date), and 10, respectively.** There is actually 37 on going PhD thesis in the CQVR that is very **impressive and showing the great dynamic and capacity of the group to develop and manage research projects.**

The CQ-VR was very productive concerning the number of published papers. **The total number of published papers in journals indexed in the Journal Citation Reports (JCR) was 87, resulting in 2.56 research papers per integrated researcher member. According to the Web of Science database, 37 research papers (43%) were published in Q1 journals, 41 (47%) in Q2 journals and 9 papers were published in Q3 journals.** 9 papers were published in newly released journals which are therefore waiting for impact factor. **Impact factor of all papers published are going from (IF = 2,474 to 7.246).** This is excellent results. The Top 15 journals used by the CQ-VR researchers for publishing their work in the 2020 period are Molecules, Water, **Antioxidants, Science of the Total Environment, Journal of Cleaner Production, Food Chemistry, Foods** , Polymers , Materials , Journal of the Science of Food

and Agriculture , Journal of Photochemistry and Photobiology A: Chemistry , **Dyes and Pigments** , Construction and Building Materials , Applied Sciences.

**5 more papers** are also published by the research group in other refereed journals.

**17 Publications in proceedings have been realized as well as 12 Communications (4 Oral and 8 Posters) presentations at international meetings have been obtained. 4 communications were developed at national meetings.**

**The Participation of research group of CQ-VR in National and International Organizations are important: in 8 Committees and in 18 decision-making bodies.**

**A Participation of the researchers of CQ-VR in editorial and special issues of international scientific journals are high: with 3 Associate Editors in International Scientific Journals, and 12 Editorial Board members in International Scientific Journals, 3 Editors of specific topics, and 10 Special Issues with Guest Editor.**

**The CQ-VR group was awarded for 5 papers with Cover Picture on :** -White Wine Protein Instability Mechanism, Quality Control and Technological Alternatives for Wine Stabilization; -Wine and Non-Dairy Fermented Beverages: A Novel Source of Pro- and Prebiotics ; - Non-Saccharomyces Yeasts and Organic Wines Fermentation: Implications on Human Health ; - Modulating Wine Pleasantness Throughout Wine-Yeast Co-Inoculation or Sequential Inoculation ; - Non-Newtonian Thermosensitive Nanofluid based on Carbon Dots Functionalized with Ionic Liquids. **A Distinction Award CNOIV was also obtained by CQ-VR in 2020** with the manuscript: "Label free DNA-based optical biosensor as a potential system for wine authenticity" published in Food Chemistry.

**The CQ-VR group was Book Editor (publisher) of 1 book Vitis: Biology and Species and published also 4 Book chapters in others scientific books on:** - Phenolics characterization of different Portuguese grape varieties, - Port Wine: Production and Ageing; - Novel Applications, Sensory and Sensor Techniques in Beverage and Food Fragrance Biotechnology; - The Colloidal State and the Micro-Science in the Beverage Industry: Emulsions, Foams, and Suspensions.

In addition, **9 Short Training and Updating courses** have been given by researchers of CQ-VR. We need to mention also that the research group contributed to some Outreach activities like the international wine competition - virtus 2020, and The V simpósio de microbiologia. The CQ-VR participated to 2 Industrial collaborative protocols and technology transfer: on Chemical and Mineralogical Tests on rock samples, and Characterization of the biomass potential of municipality of baião and technical-economic analysis of solutions for energy recovery.

**Advice, strengths and opportunities, recommendations:**

The research group of the CQ-VR is highly productive in qualitative papers and attracted significant innovative funding and grants and is recognized in the field of oenology, chemistry, microbiology, analyzes, with awards and prizes that are elements of excellence.

The scientific strategy and perspectives are well designed. In particular innovation on: grapes and wines products elaboration, quality and flavor-sensory aspects, biochemistry, ageing processes, additives alternatives, food safety, foods development of foods with innovative properties, sustainability

and by-products, new analytical methods and tools will be important for the future. Interaction with wines professional at social and economic levels could be also of interest for some topics.

The CQ-VR group can continue to work on specific and transversal projects between internal and or externals teams and can try to reinforced their number of post-Doctorate researchers and technicians.

Concerning the organization and life of the CQ-VR research unit, the group is well structured and well manage with a real Center life including leaders' teams committees' meetings, general meetings, seminars, center day, internal events, presentation of research work and advancements by the students .... The group has an academic influence and attractiveness. The organization and life of the research unit can be further improved with a sustainable development charter or a section devoted to these issues in the rules.

The CQ-VR group need to include/invest and update new equipment's in future projects on Chromatography GC/HPLC-MS, Xray equipment, Thermal analyses microscopy; and to see possible collaboration with analytical platforms when they exist. Complementary research cooperation development will be also of interest with potential partners.

The CV-QR Unit is dynamic and has a very good scientific output both qualitatively and quantitatively with several strengths. The research topics are appropriate and relevant with good perspectives The CQ-VR research team is recognized regionally, nationally and internationally.

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**Professeur**

**Directeur du Laboratoire de Chimie Appliquée**  
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**Responsable des Relations Internationales ISVV**



**Centro de Quimica – Vila Real**  
**Materials Chemistry team**

**Assessment Report on Research Activity (2019-2020)**

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Florence Babonneau (Sorbonne Université, Paris, France)  
26 July 2021

*Foreword: this report is based on the 2020 annual report of the Materials Chemistry team at CQ-VR and on the virtual meeting with the team on July 5, 2021 during which each member presented their activity followed by a discussion.*

### **Presentation of the team**

Research activities of the team are focused on the development of functional materials with applications in areas with high socio-economic and societal impacts: energy, sustainable development, health.

The team is composed of 10 members with complementary profiles - solid state chemistry and physics, materials chemistry, electrochemistry, biology, civil engineering - which is a very positive point for developing original topics in materials science. This multidisciplinary character has been strongly reinforced with the arrival in 2020 of one biologist and one civil engineer, which demonstrates the attractiveness of the team.

The team has all the skills needed to synthesize materials (by high-temperature solid state chemistry as well as soft chemistry), to process them (bulk materials and thin films) and to characterize both their structural and physical properties (electrochemical, electrical, optical, magnetic...). The range of materials they study is wide including oxides, organic-inorganic hybrids and carbons.

### **List of topics**

- Nanomaterials for sensors, fuel cells and medical therapies
- Oxide materials for electronics, biosensing and catalysis
- Hybrids for smart windows, solar concentrators, batteries, fuel cells, optics, biomedicine, and (super)hydrophobic paintings/coatings
- Industrial waste-based alkali activated cements for construction industry
- Granular-form wastes for geotechnical applications
- O-I wastes as building materials components
- Materials with heat storage capacity

### **Equipment**

The team has the main equipment necessary for these activities and has access to platforms in Portugal and Spain for certain more advanced techniques. It should nevertheless be noted that some equipment absolutely necessary for research activities on materials (XRD, SEM), must be upgraded to allow the team to consider the future with serenity. It is therefore very unfortunate for the team not to find any funding for these operations.

## Assessment of team activity

### Scientific quality and outputs

The scientific quality of the research conducted by the team is clearly measured by the recognition of the journals in which the team publishes. 64% of the articles are published in Q1 journals. The variety of journals reflects the team's fields of specialization (chemistry; electrochemistry; biochemistry; materials science; engineering; environmental sciences ...).

The production rate (56 publications in 2019 and 2020) is excellent and comparable to that of very good French teams in this field of research.

The team's work has also been featured on the cover pages of several high-quality journals (Adv. Sustainable Syst. 2019 (x2); J. Phys. Chem. C 2019; Small 2020; Langmuir 2021) and this perfectly illustrates some highlights obtained by the team: functional films for smart windows; actuators based on polymer/ionic liquid composites or biomimetic superhydrophobic coatings.

An international patent has also been filed on the use of C-dots in the biomedical field, which shows the team's willingness to protect its discoveries whenever possible.

The dynamics of the team can also be measured by its participation in international (26) and national (12) conferences. It should be noted in particular that half of these presentations are oral presentations given by almost all the team members.

Short appreciation: the scientific production is very good, in line with a dynamic of targeting high-quality journals.

### Academic reputation and attractiveness

The team, through its senior members, has acquired a good reputation which can be measured by the number of invited presentations at international (1 plenary and 2 keynote lectures) and national (1 keynote and 1 invited lecture) conferences, as well as by the participation to scientific committees of well-recognized international and national conferences.

The team has also developed an important international collaborative network, mainly in Europe (France, Germany, Luxembourg, Spain, U.K., Sweden, Norway...) as well as in Russia and Brazil.

Four members have editorial activities in several journals covering various fields: catalysis, materials in civil engineering; polymers; materials for energy... thus showing the recognition of these members in their respective specialties.

Four members have also agreed to serve as guest editors for special issues published by MDPI on topics related to current materials research areas (smart materials; water purification; fuel cells...). This is a good way to reinforce an international visibility, but one should make sure that this type of activity is not too time consuming.

The team leader is strongly involved in international evaluation bodies (Europe, Belgium, Poland, Spain), another indication of the team's reputation. Nevertheless, the lack of international contacts was highlighted by some members during the virtual meeting.

Short appreciation: the indicators concerning the academic reputation of the team are good. The efforts made to promote internationally the research work through editorial activities are to be underlined.

### Interactions with the economic environment

The team as a whole demonstrates a good capacity to seek funding. The members are very proactive in responding to calls for proposals and the coordination of several projects is carried out by the team. The main source of funding is the FCT, the Portuguese Foundation for Science and Technology, but the

team also receives European funding. It is worth noting in particular a project carried by the whole team about building sustainability which has recently been funded.

The team has limited industrial collaborative projects, and all of them are related to the development of construction materials.

Short appreciation: the team is very active in searching funding and has led several national projects. Given some of the application-oriented topics, there are certainly opportunities for the team to become more involved in private contracts.

#### Involvement in education and training

The team has a good score in the training of PhD students with 13 theses in progress and a good repartition between the different members. However, lack of students in several disciplines (physics, physical engineering, civil engineering) has been pointed out by members during the presentations. Recruitment does not seem to be sufficiently open to international students, despite the team's important network of international collaborations and its involvement in two Erasmus+ programs with ITMO University (Russia) and University of Potsdam (Germany).

Several team members are also involved in a number of specific training activities in the form of workshops aimed at various audiences (students, school teachers, general public...). The team is also strongly involved in the organization of scientific events on campus in order to popularize the research activities conducted at UTAD.

Short appreciation: the team plays an important role in the supervision of master students, PhD students and post-docs, and actively participates in a large number of training activities open to various audiences.

#### Global assessment of the team and recommendations

The team conducts research activities in a very competitive sector, which focuses on the development of functional materials for applications in the fields of energy, sustainable development and health. The team has strong skills in synthesis, processing and characterization of a wide variety of materials, and its major strength is to be multidisciplinary, which allows the development of innovative topics at the frontier between several disciplines, materials science - biology - civil engineering. The team leads several national projects and shows a good capacity to seek funding. The quality of the team's results is attested by a very good scientific production and an appreciable number of invitations to international conferences. The team has developed an important international collaborative network. The team participates actively to editorial activities and international evaluation bodies, which contributes to its reputation, and has also an excellent involvement in education and training activities.

One of the weaknesses of the team that emerged during the discussions is the limited pool of doctoral and post-doctoral students, in terms of training and origin, to which they have access. It could be suggested to the team to rely more on its international collaborations to improve its attractiveness. The visibility of the team could also be increased through an improved website, highlighting the current projects and the profiles of PhD and post-doc candidates sought by the team.

A risk to be mentioned, linked to the context, is the absence of financing for the renewal of equipment essential to the research activities of the team. What could be envisaged by the team is to try to seek funding via European projects, based on its international contacts.

## **Review of Applied Organic Chemistry Group (CQVR)**

This report reviews the activities undertaken by the Applied Organic Chemistry group of the Centro de Quimica – Vila Real, Universidade de Trás-os-Montes e Alto Douro, for the period covered by the 2019 and 2020 annual reports. Unfortunately, due to the international travel limitations imposed due to the global covid pandemic a visit to the centre was not possible, however an informative Zoom video conference was held with the group to provide a more personal overview of the group's activities. Significant areas of activity have been identified and a commentary on each is presented with good practice and weaknesses identified. The summary indicates the current level of the group's performance and also includes some suggestions on how greater research impact can be secured.

### *Annual reports*

Comprehensive annual reports which cover the various activities of the Centre (sub-groups – Applied Organic Chemistry, Materials Chemistry, Environmental Chemistry, and Food Chemistry & Biochemistry) provide a valuable annual update on various aspects of research including staffing, projects and grants, various outputs and items of esteem.

### *Staff*

The Applied Organic Chemistry Group is composed of seven enthusiastic academic (PhD) integrated members, all of which contribute the core activities of research, teaching and administration of the group, and which is comparable in size with the other research groupings at CQVR. There is a good gender balance amongst the staff and the group is comprised of a mixture of young and experienced members of staff indicating that succession management is in place. Given the competitive nature of international research and the inevitable reliance upon metrics, staff should consider making use of h-indexes and consider strategies to increase these, such as the production of high-quality reviews (either individually or in collaboration with other leading scientists) in Q1 journals.

### *Research*

The academic staff conduct both fundamental and applied collaborative research over four themes, (i) Squaraine dyes as photosensitizers for photodynamic therapy of cancer and fluorescent NIR probes for biomolecules; (ii) Calixarene-based architectures and carbon nanomaterials for sensory applications, (photo)catalysis, optoelectronic devices, bioimaging and nanomedicine; (iii) Heterocyclic photochromic compounds for application in ophthalmic lens coatings; and (iv) Isolation and identification of secondary metabolites from medicinal plants. These research themes are very timely, high interest areas and also, importantly, they are worthy of investigation considering, for example, the impact the resurgence of interest in functional dye chemistry with applications in health and wellbeing e.g. medicinal dyes and dyes for ophthalmic coatings. Additionally, activity in the design and application of sensor systems is particularly timely. One thought for the future here concerns potential collaboration within the group, for example, could the molecular motions / switching induced by the photochromic dyes be harnessed to make an opening and closing calixarene which could be actuated by light which may have applications for controlled drug release? Such combinations of research themes may enable more impactful publications to be garnered.



There are healthy numbers both for research degree completions (MSc and PhD) and for current ongoing MSc and PhD projects. Postdoctoral numbers are constant, but low (see later comments concerning research income) probably in accord with the difficulty in attracting significant research funds for their support.

### *Outputs*

The group has a sustained record of dissemination of their research results (approaching 4 outputs per annum per staff member) through publication in a wide variety of leading (Q1) and specialist journals and both the number of publications and the impact factor of the journals selected are showing an upward trend. The group has indicated an intent to further increase outputs in Q1 journals and eliminate the relatively few publications in Q2/3 journals.

The group has embraced a willingness, where possible, to engage in knowledge / enterprise activities and two national patents have been filed by the group. Where permissible, this intellectual property (IP) should be followed up with full academic papers, thus increasing the impact of their activities and furthermore, the central University should seek to exploit the IP through actively searching for appropriate national and international partners, with a share of any secured funds being fed back into the group.

It was pleasing to see data included on conference attendance / participation (chairs, committees) / presentations; it is clearly evident that the group are active in promoting their research to the wider scientific community at both the national, and importantly, international level.

### *Research Income*

Academic staff continue to be successful in attracting good levels of research funding, with a number of smaller grants and some considerable grants to support postdoctoral staff. Collaboration with other national research groups in funding applications remained evident.

The eternal question for research active staff is how to secure / increase research income during difficult financial times? The option of 'partner' or 'matched-funding' using industrial partners remains desirable and staff are encouraged to collaborate with industry, though opportunities are limited due to the limited national chemical industry.

The absence of significant funding from the European Funding Agencies / Frameworks is noted. Whilst identifying partners and completing the lengthy application is time consuming, the rewards can be substantial. Here intelligence on applications can be gathered by serving (self-nomination process) as expert reviewers for the framework programmes; the central university should make workload allowances for staff preparing such applications and provide administrative support. One option would be the introduction of research focussed sabbaticals to be employed to assist the lead applicant. A particularly attractive approach for EU funding is that of identifying strong candidates for incoming fellowship applications (e.g. contacts at conferences) – here the workload for the application is split between the incoming fellow and the academic lead applicant.

*External Relations*

The group has a good presence on the web, the website: <http://cqvr.purpleprofile.pt/applied-organic-chemistry/>, with plenty of current information concerning research students, collaborators and partnerships. The wider webpages of CQVR covers projects, knowledge transfer and publications; the latter section for the organic grouping requires some of the most recent outputs to be added.

The group is commended for their outreach activities which comprise of numerous short training courses and multiple other events to promote chemistry. The activities / celebrations arranged for the International Year of the Periodic Table are particularly noteworthy.

The WWW and social media remain paramount in promoting activities and there is a nice video released on Facebook; here the question is can even more be made of social media – blogs, twitter etc....?

*Summary*

Overall, the relatively small Applied Organic Chemistry Group are performing at a very high level across all aspects of research activities. Research output and income are very good and there is a clear vision on how to improve research activities. With support from the wider University the group will continue to thrive.

The following are suggestions, based on discussions resulting from the UK Research Excellence Framework (REF2021) exercise, to consider which may further maximise research activity, income and impact:

- Increase strategic research collaborations with Global Top 300 universities and increase number of publications with international collaborators
- Aim for general chemistry journals (JACS, Angewandte, Chem. Commun., Chem. Eur. J.,) which typically have higher impact factors than sub-discipline specific journals.
- Consider timely review articles and managing editorships of thematic virtual special issues – select journals carefully so as to avoid ‘predatory’, low impact factor journals
- Develop links / partnerships with businesses / end-users e.g. medical professionals, typically increases impact of publications
- Staff participation in grant reviewing bodies e.g. EU framework funding (esteem and access to research intelligence)
- Optimise staff time for research through creative teaching solutions (more on-line lecture / tutorial delivery and self-directed learning)
- EU and industrial funding applications

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## **Chemistry Centre – Vila Real (UTAD)**

### **Review on the Environmental Chemistry Research Group**

The research activity of the Centre is developed within the framework regarding the study, the scientific activity and the researchers' performance. The research work areas carried out by the groups focus on a) Applied Organic Chemistry; b) Materials Chemistry; c) Environmental Chemistry; and d) Food Chemistry & Biochemistry.

The General Report with the activities carried out is well structured in 8 sections. The description made in the Report allows to clearly identify the achievement of the results through the activities, as well as the detection of some weaknesses, having reached high positive results.

This report reviews the activities carried out by Environmental Chemistry Group during 2019-2020 (two years).

#### **Staff of the research group**

A truly consolidated and consistent research group is presented both for the subject matter, remarkable production and ability to obtain competitive projects, attract young talent through contracts and doctoral scholarships. The permanent staff of the Environmental Chemistry Group has 7 effective members, 4 collaborators and 13 PhD students, making it a wide group and one that has expanded substantially in recent years. The number of PhD students is very high, and together with the collaborating PhDs and the postdoctoral fellow, allowed to reach a significant scientific production in the 2019-2020 period. In the research centre, the research groups have only one technician. This could cause some maintenance problems in the research infrastructures of the groups.

#### **Research carried out at the Research Group**

The Environmental Chemistry research group holds 6 main lines of work: i) Application of advanced oxidation processes to the treatment of water and wastewater; ii) The valorisation of agroindustrial by products; iii) The organic matter, C and N cycling in soils; iv) The animal manures: P bioavailability and site vulnerability to P losses; v) The hydrogeochemistry and geomathematics; and vi) Waste recovery: resources and environment appreciation. These research lines are well defined and in accordance with the research carried out in the international area.

#### Publications

From the point of view of scientific results expressed in terms of scientific output, the assessment is highly positive. The research group has produced 45 JCR publications in the last two years: 17

are in Q1 (37.7%), 23 in Q2 (51.1%) and 1 in Q3 (2.2%). These results reveal an average of 6.5 publications per effective member of the research group in the last two years, which represents a high scientific productivity. Despite a great effort has been made, it is advisable to improve publications within Q1, although this is not always possible.

#### Funding and Technology Transfer

The Environmental Chemistry research group has obtained funding from different programs and agencies, universities, national and regional funds, European Commission and H2020 program. Within this section of funding, it is worth mentioning the three external collaborations, with Iberdrola, Câmara Municipal de Baião and Câmara Municipal de Vila Pouca de Aguiar, which have led to very interesting industrial projects such as the so-called BioCombus, among others. The group is well internationalised, with participation in European projects and mobility plans for his senior members and doctoral students. If possible, participation in other European projects would improve the funding of the research group, as well as a greater alliance with other countries in other European research agencies. It is also advisable to continue with technology transfer through contracts with industrial companies.

#### Communications in congresses

In the last two years, the group has presented 30 communications to congresses, 21 of which have been oral and 9 as posters, both international and national. It is also worth mentioning 4 publications in proceedings. This shows that the group has attended an average of 15 congresses per year, which reveals a good dissemination of the research results obtained even in a particular period of time due to the COVID-19 pandemic.

#### Editorial activity

Different members of the group have actively participated in the organization of national and international seminars and congresses. Also noteworthy is the presence of members of the group as Associate Editors and Guest Editors of journals included in the JCR. All of the above, increases the visibility of the research group at national and international level.

#### Supervision/Training

The research group shows a clear path to train PhD students, having completed two doctoral theses in the last two years. It also has 6 MSc theses and, as initially mentioned, 13 PhD students. The group also participates in 4 PhD programmes, one of them with Vigo University, Spain, and in 5 Master's programmes. The number of doctoral theses delivered in the last two years is reduced, however, it is expected that this number will increase in line with the number of current

PhD students. Research stays of foreign researchers in the research group and student stays in other research groups should be further encouraged.

### **Summary**

The research group is developing satisfactorily, both in terms of scientific and technological production and in the training of PhDs. Within this high level of quality, the following actions are recommended to improve it:

- Review and improve the plan for researcher mobility and stays, both in research groups and in companies.
- Increase the number of PhD theses.
- Explore the possibilities for industrial PhDs, in collaboration with potentially interested companies.
- To increase the sources of international funding.
- Improve technical support, through the incorporation of another technician to the centre.
- Increase the number of publications in Q1.
- The visibility of the research group could be improved by creating a web page with links to the publications made and information on the results.

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