

## BIOGRAPHICAL SKETCH

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NAME: Nicola Di Fidio

eRA COMMONS USER NAME (credential, e.g., agency login): not available

POSITION TITLE: Assistant Professor of Chemistry and Biotechnology of Fermentation

### EDUCATION/TRAINING

| INSTITUTION AND LOCATION            | DEGREE<br>(if<br>applicable) | Completion<br>Date<br>MM/YYYY | FIELD OF STUDY                     |
|-------------------------------------|------------------------------|-------------------------------|------------------------------------|
| University of Bari Aldo Moro, Italy | BS                           | 10/2013                       | Biotechnology                      |
| University of Bari Aldo Moro, Italy | MS                           | 12/2015                       | Industrial Biotechnology           |
| University of Pisa, Italy           | PhD                          | 04/2021                       | Chemistry and Materials<br>Science |
| University of Pisa, Italy           | Postdoctoral                 | 01/2022                       | Industrial Chemistry               |
| University of Pisa, Italy           | Junior<br>researcher         | 01/2025                       | Industrial Chemistry               |

### A. Personal Statement

I am a Tenure-Track Assistant of Chemistry and Biotechnology of Fermentation, and my research is focused on the design, implementation and optimisation of bioprocesses of industrial interest based on the cascade and sustainable exploitation of residual biomasses and wastes. I have a broad background in microbial biotechnology, microbiology and process technology, with specific training and expertise in the fermentation of yeasts on different synthetic and complex culture media.

As PI or co-Investigator on several university-funded grants, I laid the groundwork for the proposed research by developing different biorefinery models based on the use of the various non-conventional yeasts, such as *Kluyveromyces marxianus*, *Lipomyces starkeyi*, *Trichosporon oleaginosus*, *Cryptococcus curvatus* and *Rhodospiridium toruloides*, for the production of different added-value bio-based products, such as bioethanol, oil, fatty acids, carotenoids and microbial biomass.

I had the opportunity to work at different national and international institutions, such as Italian National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA-Trisaia), University of Bari, Racanati Multitrader s.n.c., University of Pisa, Sant'Anna School of Advanced Studies (PlantLab), Wageningen University & Research (Food & Biobased Research), and Archa Laboratories srl.

In addition, I successfully co-administered the projects, collaborated with other researchers, and produced several peer-reviewed publications from each project. As a result of these previous experiences, I am aware of the importance of frequent communication among project members and of constructing a realistic research plan, timeline, and budget. In summary, I have the expertise, leadership, training, expertise, and motivation necessary to successfully carry out the proposed research project.

### B. Positions, Scientific Appointments, and Honors

#### Positions and Scientific Appointments

2025– Present Tenure-track Assistant Professor, Department of Bioscience, Biotechnology and Environment, University of Bari Aldo Moro, Bari, Italy

2022 – 2025 Researcher, Department of Chemistry and Industrial Chemistry, University of Pisa, Pisa, Italy

2021 – 2022 Postdoc in Industrial Chemistry, Department of Chemistry and Industrial Chemistry, University of Pisa, Pisa, Italy

2018 – 2022 PhD candidate in Chemistry and Materials Science, Department of Chemistry and Industrial Chemistry, University of Pisa, Pisa, Italy

2017 – Research fellow in Chemistry and Biotechnology of Fermentation, Department of Bioscience, Biotechnology and Environment, University of Bari Aldo Moro, Bari, Italy

2016 – Technical consultant at Racanati Multitrader company (Barletta, Italy).

### Honors

2018 - Award of the special “Solvay” PRIZE on the occasion of the scientific and technological contest “Young Innovators 2018” assigned by the Municipality of Rosignano Marittimo and the chemical company Solvay. Title of the awarded scientific project: “GREENTECH OIL – integrated biorefinery in the territory”.

2019 -Award of the “Best Case Study” PRIZE on the occasion of the international conference “Making Business with Green Chemistry & Sustainable Energy 2019” assigned by the National Interuniversity Consortium of Materials Science and Technology (INSTM).

Title of the awarded scientific project: “Single Cell Oil: a potential and innovative industrial platform for the production of new generation biodiesel and bioproducts starting from biomass”.

2020 - Award of the PRIZE for third place on the occasion of the national contest for innovators “Falling Wall Lab Italy 2020” assigned by the University of Milano-Bicocca.

Title of the awarded scientific project: “Breaking the wall of the linear economy”.

2021 - Award of the special “Sustainability” PRIZE on the occasion of the conference “Catalysis at Play 2021” assigned by the Interdivisional Catalysis Group (GIC) of the Italian Chemical Society in collaboration with the international scientific journal Sustainable Chemistry (MDPI).

2021 - Award of the “Adolfo Parmaliana 2021” PRIZE for the best doctoral thesis in “Catalysis for Sustainable Development” assigned by the Italian Chemical Society.

Title of the thesis: “Innovative process for the conversion of residual biomass into high added-value products combining chemical and biological catalysis”.

2022 - Award of the Primo Levi 2021 PRIZE entitled “Top 10 articles published in 2021 in international journals in the field of Chemical Sciences by scientists under 35 members of the Italian Chemical Society” assigned by the Italian Chemical Society for the scientific publication entitled “Integrated cascade biorefinery processes for the production of single cell oil by *Lipomyces starkeyi* from *Arundo donax* L. hydrolysates”, Bioresour. Technol. 325 (2021) 124635.

2023 - Award of the “Best Oral Presentation” PRIZE on the occasion of the 4th Workshop “Chemists for Biotechnologies” at the University of Parma organised by the Interdivisional Biotechnology Group of the Italian Chemical Society. The awarded contribution was entitled “Green valorisation of defatted waste of *Cynara cardunculus* L. to single cell oil and high-quality lignin”.

2024 - Award of the con.Sienze 21/22 PRIZE for the best doctoral thesis in Chemistry, entitled “Innovative process for the conversion of residual biomass into high added-value products combining chemical and biological catalysis” assigned by the National Conference of Presidents and Directors of University Structures of Science and Technology.

### C. Contributions to Science

My research activity focuses on the study, implementation, and optimisation of innovative catalytic processes of industrial relevance aimed at fostering the transition from fossil-based to renewable waste feedstocks for the production of chemicals, materials, and fuels, as well as the adoption of reaction conditions with a low environmental impact. In general, my research activity aims to implement the principles of green chemistry and the circular economy within modern integrated biorefinery schemes, in which one or more waste biomasses derived from the agro-industrial and/or food supply chain are used as renewable raw materials for the synthesis of high added-value products, either for direct application in established industrial processes or as chemical

platforms for the synthesis of other commercially relevant molecules. The distinctive feature of this research activity lies in the development of innovative process schemes based on a synergistic combination of chemical catalysis and biocatalysis. The adoption of highly versatile catalytic strategies, ranging from homogeneous and heterogeneous chemical catalysis to biocatalysis with enzymes and whole cells, allows the optimisation of tailor-made integrated processes for the complete conversion of waste biomasses into value-added molecules of industrial interest. Furthermore, the combination of chemical and biological catalysis promotes the adoption of more environmentally sustainable reaction conditions, thanks to greater process flexibility depending on the type of substrate and, above all, the target product. In order to define the best process strategies for the tailored valorisation of each waste biomass employed as raw material, my research has also focused on acquiring a wide range of biomass characterisation methodologies: quantitative and qualitative analysis of biomass chemical composition, infrared and ultraviolet/visible spectroscopy, X-ray diffraction, fibre size analysis, optical microscopy, elemental analysis, thermogravimetric analysis, size exclusion chromatography, BET analysis, porosimetry techniques for determining surface area, pore area and volume, and pore volume distribution, as well as adsorption kinetics tests for CO<sub>2</sub> uptake. During the research activity, in order to fully valorise the polysaccharide and lignin components of each type of biomass, environmentally friendly cascade processes based on various combinations of chemical and biological catalysts were developed. In particular, homogeneous chemical catalysis approaches, based on the use of acids such as sulphuric acid, hydrochloric acid, and ferric chloride, and heterogeneous catalysis approaches, based on the use of the acidic ion-exchange resin Amberlyst-70, were investigated. Reactivity studies in laboratory-scale Parr autoclaves were also conducted on biomass pre-treated with carbon dioxide under subcritical and supercritical conditions. To these were added biotechnological approaches based on the use of commercial enzymes, such as cellulases, hemicellulases, proteases, and lipases, and whole cells, such as the oleaginous yeasts *Cutaneotrichosporon oleaginosus*, *Lipomyces starkeyi*, *Rhodospiridium toruloides*, *Trichosporon oleaginosus*, *Yarrowia lipolytica*, and lactic acid bacteria, including *Lactobacillus brevis*, *Lactobacillus plantarum*, and *Lactobacillus reuteri*. In addition, for the valorisation of the lignin fraction through electro-oxidative depolymerisation, various catalysts such as graphite, nickel oxyhydroxide, and platinum were studied and optimised, both through cyclic voltammetry and constant-potential electrolysis. In all the biorefinery schemes developed, reactions were carried out in accordance with Green Chemistry methodologies, always using water or organic solvents derived from renewable resources and adopting, whenever possible, innovative reactors based on microwaves, ultrasounds, or constant electric fields (ohmic heating). Moreover, the optimisation of the main process parameters was often conducted using chemometric approaches, such as design of experiments (DoE) and response surface methodology. Furthermore, in all cascade processes developed, both upstream and downstream process stages were studied and optimised, with particular attention paid to closing the carbon cycle. Finally, my research has also focused on the qualitative and quantitative characterisation of products of interest using various analytical techniques, including liquid chromatography (HPLC/UPLC), gas chromatography (GC), mass spectrometry (MS), and IR and UV-VIS spectroscopy.

Participation to international projects:

2024-2025 – Project acronym: “FLEXIZYME”, European call: HORIZON-JU-CBE-2023, type of action: HORIZON-JU-RIA, proposal number: 101157528, duration: 48 months, project title: “Construction of a FLEXible and adaptable ENZYmatic biotechnological platform for sustainable industrial production of bio-based Fatty amines from side stream materials”.

Activity: HORIZON-JU-CBE-2023-R-03. Participation as a member of the University of Pisa Research Unit.

2018–2023 – Project acronym: LignoCOST – European COST Action CA17128).

Duration: 48+6 months.

Research activity: laboratory- and pilot-scale research, literature review and analysis, techno-economic, environmental, and social assessments (LCA), and dissemination activities characterised participation in LignoCOST. The specific working group in which these activities were carried out was “Working Group No. 2: Bio- and chemo-catalytic conversion technologies, including assessment of the technology readiness level (TRL)”. Within LignoCOST, a six-month research stay abroad was undertaken, funded by the COST Action; an international online conference (September 2021) and a second international conference held in person at the University of Pisa (March 2023) were organised, alongside participation in several summer schools, working group meetings, and international conferences.

#### Participation to national projects:

2023–2025 – Project acronym: “ReFil”, national call: PRIN – Projects of Relevant National Interest 2022 (Italian Ministry of Universities and Research – MUR), proposal number: Prot. 2022KA5WL8, duration: 24 months, project title: “Renewable liquid Fuel of new generation from wastewater sludge: a step towards circular economy”. Consortium of three university partners (PI: Prof. Anna Maria Raspolli Galletti, UniPi).

ReFil aims to develop an integrated and multidisciplinary biorefinery approach for the valorisation of the chemical and energy potential of sewage sludge, which represents an abundant and critical special waste derived from urban wastewater treatment. Indeed, sewage sludge (currently requiring costly disposal) can serve as a valuable source of lipids and cellulose, both to be exploited as low-cost alternative precursors for the synthesis of biofuels, such as next-generation biodiesel from microbial oils and alkyl levulinates. The integration of chemical and biotechnological technologies and processes for the conversion of different waste fractions into selected bioproducts is a key strength of the project.

Participation as a member of the University of Pisa Research Unit.

#### Participation to regional projects:

2021 – Project acronym: “Greenfiber” – Project funded by Fondazione Cassa di Risparmio di Lucca – Call 2019–2021 “Research”.

Research activity: catalytic valorisation of cellulose fibres present in sludge from wastewater treatment in tissue paper production processes.

2021 – Project acronym: “MASTERB” – Project funded under POR FESR Toscana 2014–2020, RS 2017 Call 2, Regione Toscana-D55F17000070009.

Research activity: the MASTER-B project explored the reuse of olive mill wastewater and spent coffee grounds to develop production processes for concentrated polyphenol-based extracts.

#### Participation to university projects:

2022–2024 – University Research Project (PRA) 2022–2023 – Member of the research unit awarded the PRA entitled “New challenges of transition metal and lanthanide complexes in the perspective of green chemistry” (PI: Prof. Claudia Antonetti). Period: from 10/10/2022 to 31/12/2024 (duration: 24 months).

Research activity: synthesis of new ruthenium-based organometallic complexes for homogeneous catalysis in catalytic transfer hydrogenation reactions of ethyl levulinate to  $\gamma$ -valerolactone.

#### Complete List of Published Work in Scopus database:

<https://www.scopus.com/authid/detail.uri?authorId=57194336585>

Date 29/09/2025

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