

PERSONAL INFORMATION

Federica Forte



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Sex F | Date of birth 27/09/1984 | Nationality Italian

WORK EXPERIENCE

01/02/2019 - present

Researcher

at ENEA, Italian National Agency for New Technologies, Energy and Sustainable Economic Development.

Department for Sustainability (SSPT), Division Resource Efficiency (USER), Laboratory Technologies for the Reuse, Recycling, Recovery and valorisation of Waste and Materials (T4RM), Casaccia Research Center.

Her main scientific interests fall within the framework of the European strategies and initiatives in the field of circular economy in which the laboratory operates and concern the development and optimization of processes for the valorisation of complex matrices using hydro-, iono- and solvometallurgical techniques. In particular, she is working on a research line focused on the recovery of materials from lithium iron phosphate (LFP) batteries.

She is member of working group 2 (Raw Materials and Recycling) of [Batteries Europe](#) and she is involved in the activities of the [Italian phosphorus platform](#), aimed at promoting the sustainability of the phosphorus value chain.

16/03/2015 - 31/01/2019

Postdoc researcher

Catholic University of Leuven (KU Leuven), Department of Chemistry, Celestijnenlaan 200F - box 2404, 3001 Leuven, Belgium.

She was part of the SIM² KU Leuven (*Sustainable Inorganic Materials Management*, <http://kuleuven.sim2.be/>), active in the development and optimization of eco-innovative processes for the valorization of different type of waste streams (End-of-Life products, industrial residues, mining waste etc.). In particular her activity belonged to research line n. 2 (*Critical Metal Recovery*), focused on the development of rare earths and other critical raw materials recovery processes by means of pyro-, hydro-, solvo-, iono- and electrometallurgical techniques.

She worked as KU Leuven project leader at the EU H2020 REMAGHIC project (*New recovery processes to produce rare earth-magnesium alloys of high performance and low cost*; Grant Agreement number: 680629; 1 September 2015 – 31 August 2018).

The experimental work was focused on rare earths recovery from spent fluorescent lamps, CRTs and NiMH batteries. Within this project she worked as *internship mentor* (*Internship project: Recovery of yttrium and europium from CRTs phosphor waste*).

She worked at the development of a recovery process for lead from industrial waste streams by solvometallurgical techniques within the project IWT MIP ICON MaxiVia (*Maximum Valorization of Ferrous Industrial Waste streams*; 1 November 2014 – 31 October 2016).

EDUCATION AND TRAINING

01/10/2011 - 17/12/2014

PhD in Environmental and Infrastructure Engineering

Politecnico di Milano, Department of Civil and Environmental Engineering
Piazza Leonardo da Vinci 32, 20133, Milan

Experimental activity carried out at ENEA, Casaccia Research Center.

Title: Materials recovery from liquid crystals displays: a focus on indium

Title: with merit

Supervisor: Prof. Mario Grosso

Assistant Supervisor: Dr. Danilo Fontana, ENEA

Tutor: Prof. Michele Giugliano

She has been the assistant supervisor of three master thesis students (Politecnico di Milano, Master of Science in Environmental and Land Planning Engineering):

1. *Studio di tecnologie innovative per il trattamento e la valorizzazione dei residui della depurazione dei fumi da incenerimento di RSU* (Tomasella Lisa, academic year 2011/2012)
2. *Material Flow Analysis on Domestic High Value WEEE Generation and Collection in Finland* (Bruno Pannuzzo, academic year 2012/2013)
3. *Urban mining: the recovery of critical metals from waste electrical and electronic equipment (WEEE). The case of indium* (Giulia Pizzagalli, academic year 2013/2014)

22/02/2011 **Master Degree in Environmental and Land Planning Engineering**

Università degli Studi di Napoli, Federico II

Experimental activity carried out at ENEA, Casaccia Research Center.

Title: Il recupero del cobalto e del manganese da catalizzatori industriali esausti (Cobalt and manganese recovery from spent industrial catalysts).

Score: 110/110 *cum laude*

Supervisor: Prof. Ing. Francesco Pirozzi

Assistant supervisor: Dr. Danilo Fontana, ENEA

PERSONAL SKILLS

Mother tongue Italian

Other languages English; professional knowledge

Organizational and management skills Excellent ability to work in teams and in multicultural environments; attitude to problem solving; excellent ability to manage responsibilities and prioritise work with respect to set deadlines and objectives.

Professional skills Development and optimization of *critical raw materials* (CRM) recovery processes from several types of wastes (fly ash, WEEE, industrial residues).

Idrometallurgy, ionometallurgy, solvometallurgy.

Life Cycle Assessment (LCA) applied on waste management and treatment.

Knowledge and application of the main aspects Project Management.

Knowledge and application of the following analytical techniques: UV-VIS, FTIR, AAS, MP-AES, ICP-OES, TXRF.

Good knowledge of Microsoft applications and Office package.

Driving licence B

PUBLICATIONS

Peer reviewed papers

M. Pietrantonio, S. Pucciarmati, G. N. Torelli, G. D'Aria, F. Forte and D. Fontana. Towards an integrated approach for red mud valorisation: a focus on titanium. *Int. J. Environ. Sci. Technol.*, 2020. <https://doi.org/10.1007/s13762-020-02835-5>.

F. Forte, S. Riaño and K. Binnemans. Dissolution of noble metals in highly concentrated acidic salt solutions. *Chem. Commun.*, 2020. <https://doi.org/10.1039/D0CC02298E>.

F. Forte, M. Pietrantonio, S. Pucciarmati, M. Puzone and D. Fontana. Lithium iron phosphate batteries recycling: An assessment of current status. *Crit. Rev. Env. Sci. Tec.*, 2020. <https://doi.org/10.1080/10643389.2020.1776053>.

D. Fontana, F. Forte, M. Pietrantonio and S. Pucciarmati. Recent developments on recycling end-of-life flat panel displays: A comprehensive review focused on indium. *Crit. Rev. Env. Sci. Tec.*, 2020. <https://doi.org/10.1080/10643389.2020.1729073>.

D. Fontana, M. Pietrantonio, S. Pucciarmati, C. Rao and F. Forte. A comprehensive characterization of End-of-Life mobile phones for secondary material resources identification. *Waste Manage.*, 2019 (99), 22–30.

L. Yurramendi, L. Gijsemans, F. Forte, J. L. Aldana, C. del Río and K. Binnemans. Enhancing rare-earth recovery from lamp phosphor waste. *Hydrometallurgy* 2019 (187), 38–44.

R. Banda, F. Forte, B. Onghena and K. Binnemans. Yttrium and europium separation by solvent extraction with undiluted thiocyanate ionic liquids. *RSC Adv.* 2019 9, 4876–4883.

F. Forte, L. Yurramendi, J. L. Aldana, B. Onghena and K. Binnemans. Integrated process for the recovery of yttrium and europium from CRT phosphor waste. *RSC Adv.*, 2019 (9), 1378–1386.

L. Gijsemans, F. Forte, B. Onghena and K. Binnemans. Recovery of rare earths from the green lamp phosphor $\text{LaPO}_4: \text{Ce}^{3+}, \text{Tb}^{3+}$ (LAP) by dissolution in concentrated methanesulphonic acid. *RSC Advances*, 2018 (8), 26349–26355.

F. Forte, L. Horckmans, K. Broos, E. Kim, F. Kukurugya and K. Binnemans. Closed-loop solvometallurgical process for recovery of lead from iron-rich secondary lead smelter residues. *RSC Advances* 2017 (7), 49999–50005.

D. Fontana, F. Forte, R. De Carolis, M. Grosso. Materials recovery from waste liquid crystal displays: A focus on indium. *Waste Management* 2015 (45), 325–333.

L. Biganzoli, A. Falbo, F. Forte, M. Grosso, L. Rigamonti. Mass balance and life cycle assessment of the waste electrical and electronic equipment management system implemented in Lombardia Region (Italy). *Science of the Total Environment* 2015 (524–525), 361–375.

L. Biganzoli, M. Grosso, F. Forte. Aluminium Mass Balance in Waste Incineration and Recovery Potential From the Bottom Ash: A Case Study. *Waste and Biomass Valorization* 2014 (5), 139–145.

Conference papers

L. Yurramendi, F. Forte, C. Del Río, R. Lagioia, A. Salles, T. Müller, S. Sgarioto, K. Binnemans. Recovery of rare earths from e-waste residues by an integrated approach. 4th International Symposium on Enhanced Landfill Mining, Mechelen (Belgium), 05-06 February 2018. ISBN: 9789082825909. Pp. 127–132.

F. Forte, L. Yurramendi, J. L. Aldana, C. Del Río, R. Banda, L. Gijsemans, K. Binnemans. Integrated flow sheet for the recovery of rare earths from CRTs and lamp phosphor waste. 2nd Conference on European Rare Earth Resources (ERES 2017), Santorini (Greece), 28–31 May 2017. Pp. 212–213.

L. Yurramendi, F. Forte, C. Del Río, R. Lagioia, T. Müller, S. Sgarioto, K. Binnemans. Recovery of rare earths from e-waste residues for production of high-performance REE-Mg alloys. 2nd Conference on European Rare Earth Resources (ERES 2017), Santorini (Greece), 28-31 May 2017. Pp. 205–206.

L. Biganzoli, A. Falbo, F. Forte, L. Rigamonti, M. Grosso. LCA of the WEEE management system in

Lombardia. 4th International Conference on Industrial and Hazardous Waste Management, Chania (Crete - Greece), 2–5 September 2014.

A. Falbo, L. Biganzoli, F. Forte, L. Rigamonti, M. Grosso. MFA e LCA del sistema di gestione dei RAEE in Regione Lombardia: focus sui piccoli elettrodomestici. VIII Convegno Scientifico della Rete Italiana di LCA, Firenze (Italy), 19-20 June 2014. S. Scalbi and A. Dominici Loprieno, ENEA edition, Roma, pp. 220–226 (ISBN: 978-88-8286-306-7).

D. Fontana, F. Forte, R. De Carolis, M. Grosso. Indium recovery from waste liquid crystal displays. Second Symposium on Urban Mining (SUM 2014), Bergamo (Italy), 19–21 May 2014 (ISBN: 978-88-6265-031-1).

A. Falbo, L. Biganzoli, F. Forte, M. Grosso. LCI of the WEEE management system in Lombardia Region. A focus on R3 and R4 categories. Second Symposium on Urban Mining (SUM 2014), Bergamo (Italy), 19–21 May 2014 (ISBN: 978-88-6265-031-1).

F. Forte, L. Biganzoli, A. Falbo, M. Grosso. LCA of the WEEE management system in Lombardia Region. Part I: a focus on the current WEEE treatment practices. 2nd International Conference WASTE: Solutions, Treatment and Opportunities, Braga (Portugal), 11-13 September 2013. Pp. 563–568.

D. Fontana, F. Forte. Cobalt and manganese recovery from spent industrial catalysts by hydrometallurgy. 2nd International Conference on Sustainable Intelligent Manufacturing, SIM 2013, Lisbon (Portugal), 26–29 June 2013. CRC Press Taylor & Francis Edition, pp. 203-208 (ISBN: 978-1-138-00046-9).

D. Fontana, F. Forte. Cobalt and manganese recovery from spent catalysts. Ecomondo 2011, 9–12 November 2011, Rimini, Italy. Maggioli Editore, pp. 880–885.

Other publications

V. Fantin, A. Giuliano, P. L. Porta, G. Barberio, C. Brunori, C. Chiavetta, D. Claps, R. De Carolis, D. Fontana, F. Forte, A. Genovese, E. Mancuso, C. Mingazzini, M. Pasquali, M. Puzone, L. Meini, F. Panvini, A. Loporcaro, G. Incarico, E. Maniscalco, M. Capellini, R. Vannucci, M. Giombini, C. Piazza, C. Prelli, P. De Sabbata, C. Naccarato, D. Fontana, C. El Khoury, E. Rizzuto, F. Naso, S. Colombo, F. Servalli, E. Casucci, A. Sterpellone, G. Mauri, C. Giardina. L'economia circolare nelle filiere industriali: i casi tessile, abbigliamento e moda (TAM) e mobilità elettrica. ICESP Gruppo di Lavoro 4 "Sistemi di progettazione, produzione, distribuzione e consumo sostenibili e circolari". Luglio 2020. doi. 10.12910/DOC2020-005.

D. Fontana, F. Forte, P. L. Porta, M. Puzone, M. Pasquali. Le batterie al litio: catena del valore e chiusura del ciclo. Energia, ambiente e innovazione 3/2019, 125-127.

D. Fontana, M. Pietrantonio, S. Pucciarmati, F. Forte. Il recupero di metalli di elevato valore da schede elettroniche fuori uso: una soluzione tecnologica avanzata. La Termotecnica 2019, 28-31.

B. Araujo, F. Forte. REMAGHIC, New Recovery Processes to produce Rare Earth-Magnesium Alloys of High Performance and Low Cost, H2020, Volume 2018, Number 5, August 2018, 56-58, Science Impact Ltd.

Projects

EU H2020 PLATIRUS project (PLATInum group metals Recovery Using Secondary raw materials)

EU H2020 REMAGHIC project (New Recovery Processes to produce Rare Earth-Magnesium Alloys of High Performance and Low Cost). Main role: project leader.

IWT MIP ICON MaxiVia project (Maximum Valorization of Ferrous Industrial Waste streams).

Courses and Certifications

Certificate of attendance to the RSPP Course (Training Course for Prevention and Protection Service Managers, Module C).

B2 Certificate released from the British Institute on 22/09/2011.

Qualification to practice as an Engineer (Section A, Sector: Civil and Environmental) obtained from

Università degli Studi di Napoli Federico II (exam on the first session of year 2011).

Registration in the Professional Register of Engineers of the Province of Avellino on 18/01/2013.

Rome, 22/10/2020

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