

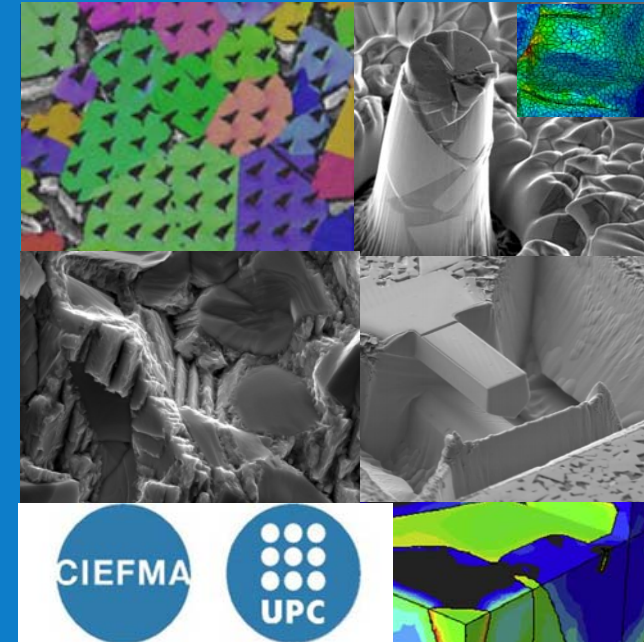


UNIVERSITAT POLITÈCNICA  
DE CATALUNYA  
BARCELONATECH

## Sustainable design of material solutions for structural- and energy- related applications

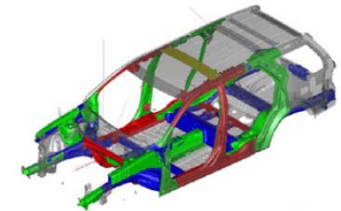
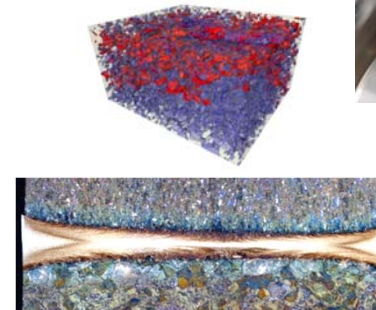
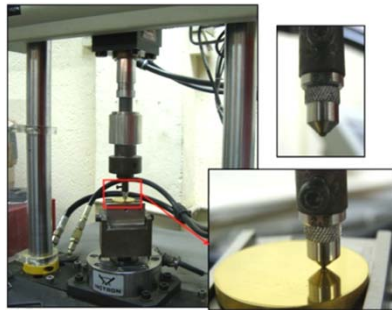
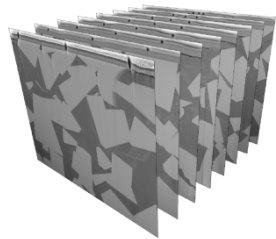
Centre d'Integritat Estructural, Micromecànica  
i Fiabilitat dels Materials - CIEFMA

February 2023





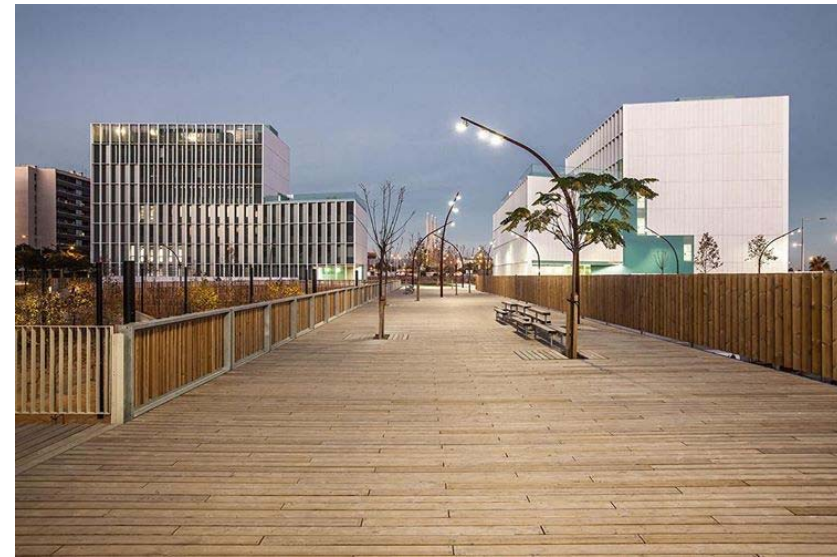
- Center for Research in Structural Integrity, Micromechanics and Reliability of Materials (CIEFMA)
- Critical Raw Materials within CIEFMA's scope
- Ongoing research activities and collaborative efforts





## Center for Research in Structural Integrity, Micromechanics and Reliability of Materials (CIEFMA)

- Microstructural design of high-strength metallic alloys
  - Structural durability of joint structures
  - Surface integrity of cutting and forming tools
  - Small-scale mechanical behavior of materials
  - Degradation of materials under service-like conditions
  - Understanding hydrogen-materials interactions
  - Additive manufacturing of ceramic materials
  - Surface modification technologies for SOFC and SOECs
- Currently about 35 people, including 22 PhD Thesis in progress



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Generalitat  
de Catalunya





## Sustainable design of material solutions for structural applications

- Tooling (metal cutting, mining and wear applications) is built on critical and scarce raw materials (CRMs), particularly cobalt (Co) and tungsten (W)
- Cemented carbides account for about 65 percent of the entire global tooling market just in metal cutting area, and over 1 billion of tool bits of only WC-Co is produced and consumed annually
- Cemented carbides account for 60% and 14% of the worldwide use of tungsten and cobalt respectively.



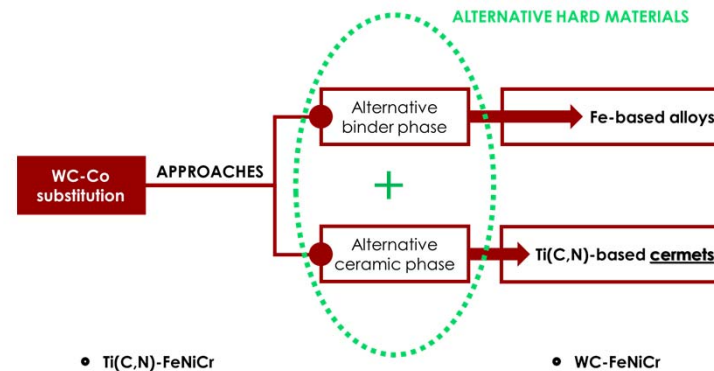
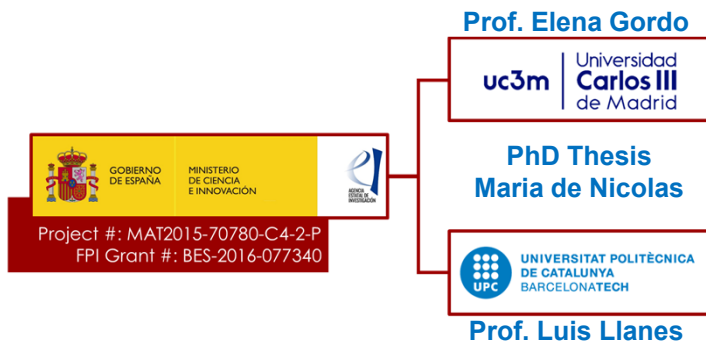
Development of alternative hard materials,  
regarding both metallic binder and ceramic particles

Critical metals recovery from  
industrial scraps



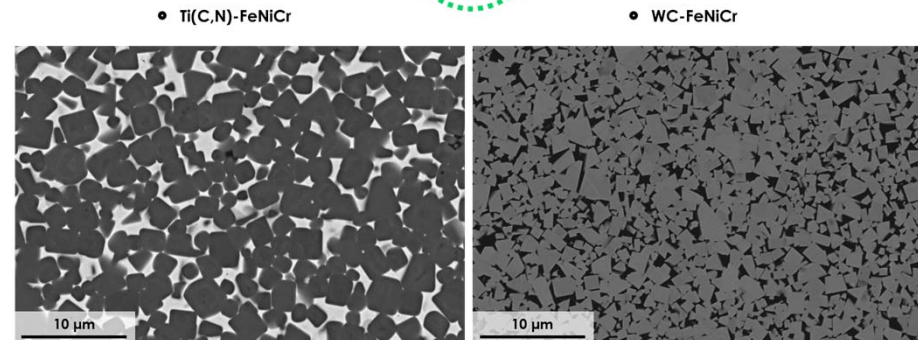


## Development of alternative hard materials, regarding both metallic binder and ceramic particles



Phase diagrams in alternative hard materials: Validation of thermodynamic simulation through high temperature x-ray diffraction, differential thermal analysis and microstructural characterization

M. de Nicolás<sup>a,\*</sup>, L. Pereira<sup>b</sup>, M. Penoy<sup>b</sup>, C. Bertalan<sup>b</sup>, R. Useldinger<sup>b</sup>, L. Llanes<sup>c,d</sup>, E. Gordo<sup>a</sup>





# Critical metals recovery from Hardmetal industrial scraps



Università degli Studi di Cagliari  
Supervisor:  
Prof. Angela Serpe  
Co-Supervisor:  
Prof. Giorgia De Gioannis



Fabbrica Italiana Leghe Metalliche Sinterizzate  
Co-Supervisor:  
Dott. Ing. Gian Pietro De Gaudenzi



Universitat Politècnica de Catalunya  
Co-Supervisor:  
Prof. Luis Miguel Llanes Pitarch

# Design and implementation of non-CRM materials for future applications

Call: HORIZON-MSCA-2022-DN-01  
(MSCA Doctoral Networks 2022)  
Topic: HORIZON-MSCA-2022-DN-01-01  
Type of Action: HORIZON-TMA-MSCA-DN

10 PhD Thesis

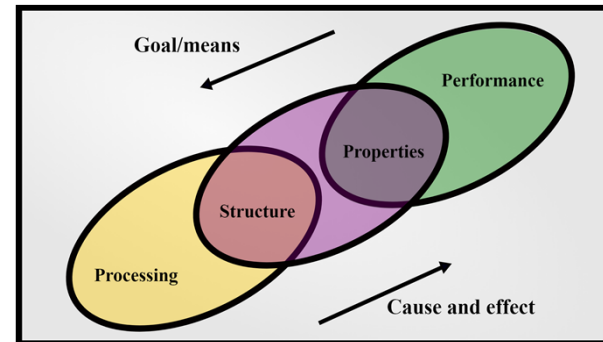


A new facile solvometallurgical leaching method for the selective Co dissolution & recovery from hard metals waste

Amadou Omarou Amadou<sup>a</sup>, Gian Pietro De Gaudenzi<sup>b</sup>, Giancarlo Marcheselli<sup>b</sup>, Stefano Cara<sup>c</sup>, Martina Piredda<sup>d</sup>, Daniela Spiga<sup>e</sup>, Avtar S. Matharu<sup>f</sup>, Giorgia De Gioannis<sup>g,h</sup>, Angela Serpe<sup>h,i,j,k</sup>

<sup>a</sup> Department of Civil and Environmental Engineering and Architecture (DICA-AR), University of Cagliari, Piazza d'Armi, 09123 Cagliari, Italy  
<sup>b</sup> Fabbrica Italiana Leghe Metalliche Sinterizzate (F.I.L.M.S.I.) SpA, Via Melpino 6, 20077 Anzola d'Ossola, VB, Italy  
<sup>c</sup> Environmental Geology and Geoengineering Institute of the National Research Council (IGAG-CNR), Piazza d'Armi, 09123 Cagliari, Italy  
<sup>d</sup> Green Chemistry Centre of Excellence, Department of Chemistry, University of York, Heslington, York YO10 5EB, United Kingdom  
<sup>e</sup> Unit of National Interuniversity Consortium for Materials Science and Technology (INCTM), Via Giuseppe Galvani 9, 50122 Florence, Italy

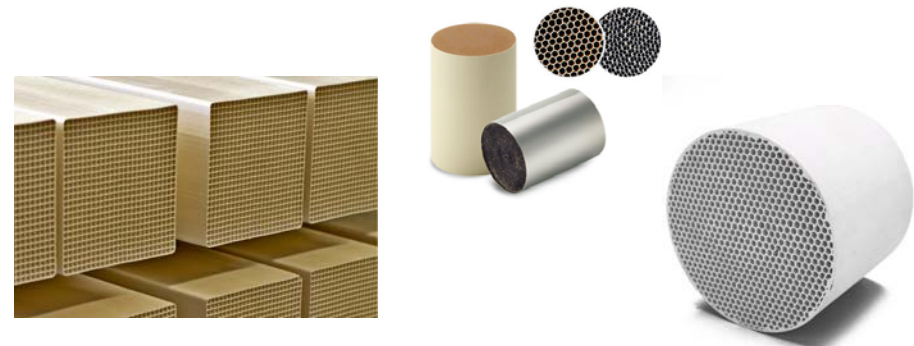
PhD Thesis





## Sustainable design of material solutions for energy-related applications

- Use of CRMs (Co,Ni) in catalytic monoliths as well as in anodes within SOFCs and SOECs



**Additive manufacturing of ceramics for catalytic applications**

**Monoliths of zirconia and alumina with complex shapes  
Functionalization of scaffold struts  
by means of metal or ceramic coating**

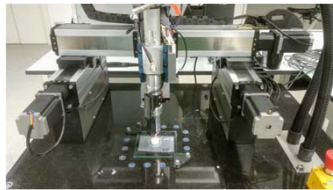
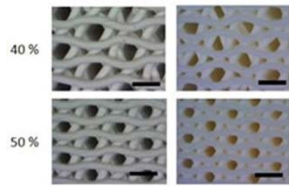
**Optimization of multifunctional performance  
of SOFCs and SOECs**

**Small-scale mechanical testing  
Reliable performance under service-like conditions**

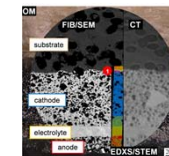
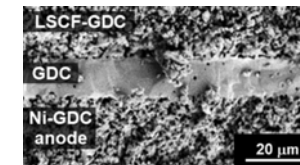
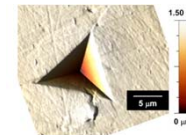




## Postprocessing of Amed ceramics



## Experimental and simulation study of SOFC/SOEC performance







**Thank you for your attention!**

**Comments and queries are welcome**

**Luis Llanes**  
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