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# 2nd Annual Meeting of ARIES WP17: Welcome and Introduction

Video Meeting,
13.07.2020

**Marilena Tomut, Alessandro Bertarelli**
on behalf of the ARIES WP17 collaboration

# ARIES WP17 PowerMat

- Welcome to the **2nd (Virtual) Annual Meeting** of the ARIES WP17 PowerMat, following 1st Annual Meeting in Malta, in October 2018
- This event was initially planned for March 2020 at ELI-NP in Magurele, Romania, which was eventually cancelled because of COVID-19 outbreak …
- … **thanks** anyway to **local organizing committee** and **Marilena** for having performed **all the preparatory work**. We still hope to meet in this brand new facility in a not-too-far future!

# PowerMat WP in a nutshell

- Develop and characterize novel composite materials based on graphitic and metal matrices with carbide and diamond reinforcements
- Test and online monitor materials behaviour under thermal shock (particle- or laser-beam induced) and irradiation
- Investigate radiation damage using numerical and experimental approaches.
- Identify and test novel materials for broader accelerator applications for high power targets, beam catchers, beam windows  and luminescence screens
- Explore societal applications of these novel materials such as advanced engineering, medical imaging, quantum computing, energy efficiency, aerospace, and thermal management

# WP17 Organization

- WP17 (**PowerMat**): **6 main beneficiaries** (**CERN, GSI, POLITO, POLIMI, ELI-NP, UMALTA**), **1 associate** (**NIMP**) from 5 different countries
- **Strong interaction** with **WP14** (**Promoting Innovation**)
  - **1 beneficiary industry** (**RHP-Technology, AT**), **1 associate industry** (**Brevetti Bizz, IT**) in **Task 14.4** (F. Carra, CERN)
- **JRA** is organized in **5 Tasks**:
  - 17.1: **Communication & Coordination**
    A. Bertarelli, CERN; M. Tomut, GSI
  - 17.2: **Materials development and characterization**
    A. Bertarelli, CERN
  - 17.3: **Dynamic testing and online monitoring**
    L. Peroni, POLITO
  - 17.4: **Simulation of irradiation effects and mitigation methods**
    A. Lechner, CERN
  - 17.5: **Broader accelerator and societal applications**
    M. Tomut, GSI

# ARIES WP17 PowerMat: Objectives of the meeting I

- **Review** and **present work progress** in last 18 months
- **Discuss** and **decide** about activities in the final months, noting that:
  - **ARIES** project may be **extended** by at least 6 months because of COVID, but should avoid significant overlap with I-FAST (new H2020 project)
  - TNA (e.g. **HiRadMat**) activities to be extended by 12 months
  - A **modular approach** may be negotiated, with some WP extended by 12 months (WP17?)
  - A **proposal** to be discussed **in early autumn '20** at the Steering Board, also taking into account **COVID evolution** …

# ARIES WP17 PowerMat: Objectives of the meeting II

- **Main activities** to come in future months, largely affected by COVID outbreak:
  - **2nd irradiation campaign at GSI**
    - approved and initially planned for spring 2020; postponed to 2021, formal approval pending ..
    - Goal is to improve/extend findings of 2019 irradiation and test latest material grades
  - **Dynamic characterization tests at high temperature** in POLITO
    - Postponed due to lockdown and delays in delivery of dedicated vacuum chamber
    - New timeline to be defined
  - **High power laser beam experiments** at ELI-NP
    - Laser beam impacts represent a unique opportunity to test effects on material of not-yet-available high intensity/energy particle beams, without many downsides of particle irradiation
    - New timeline to be defined; discussion on feasibility, energy and time scales, acquisition methods to be held at this meeting
  - Workshop "**Extreme Beams meet Extreme Materials**" (MS62)
    - To be replaced by virtual workshop or by a different format

# ARIES WP17 PowerMat: Meeting Timetable

- **One day meeting**
- 4 presentation sessions
  - Task 17.2 combined with 14.4
  - Task 17.3
  - Task 17.4
  - Task 17.5
- 2 discussion sessions
  - Morning: Discussion on shock experiments on accelerator materials with lasers and high energy beams
  - Afternoon: Wrap-up and discussion on future plans and activities

# Milestones

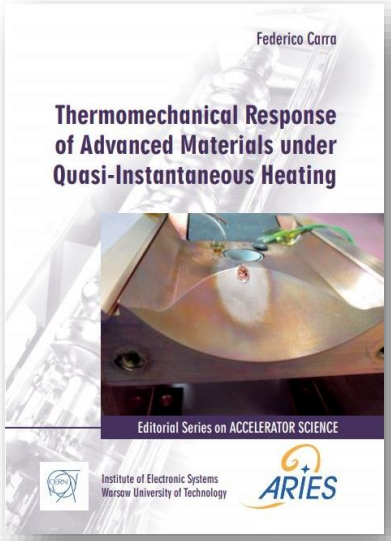
| Milestone number[18] | Milestone title | WP number[9] | Lead beneficiary | Due Date (in months)[17] | Means of verification |
|---|---|---|---|---|---|
| MS58 | Organisation of PowerMat kick-off meeting (Task 17.1) | WP17 | 1 - CERN | 6 | Agenda, summary report |
| MS59 | Irradiation campaigns at GSI for radiation hardness studies (Task 17.3) | WP17 | 23 - POLITO | 27 | Report to StCom |
| MS60 | Irradiation effects analysis (Task 17.3) | WP17 | 1 - CERN | 36 | Report to StCom |
| MS61 | Comparative compendium of materials developed (Task 17.2) | WP17 | 1 - CERN | 40 | Report to StCom |
| MS62 | Dissemination of R&D results on novel materials for accelerator and societal applications (Task 17.5) | WP17 | 12 - GSI | 46 | Report to StCom |

# Deliverables

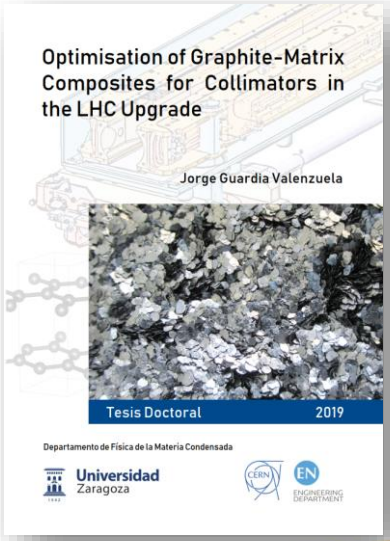
| Deliverable Number[14] | Deliverable Title | Lead beneficiary | Type[15] | Dissemination level[16] | Due Date (in months)[17] |
|---|---|---|---|---|---|
| D17.1 | Material characterization | 1 - CERN | Report | Public | 12 |
| D17.2 | Irradiation effect simulations | 1 - CERN | Report | Public | 44 |
| D17.3 | Irradiation test results | 23 - POLITO | Report | Public | 46 |

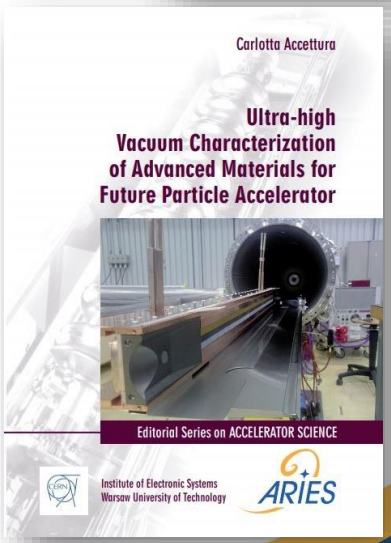
# WP17 Outreach: Publications

- 10 PowerMat-related **Articles** and 2 **Theses** (PhD and Master) uploaded in **Zenodo**
- 2 additional **PhD theses** including one with **IP-sensitive** content with deferred publication
- **Open Access** articles in **Carbon** and **Acta Materialia** journals
- Two volumes in **ARIES monographs** published by WUT
- **Special Issue** in Shock and Vibration devoted to Structural and Wave Propagation Effects in High-Energy Particle Impacts)







# What's next - IFAST – WP4.3

- **IFAST Task 4.3. - GRAPH&BEAWIN**

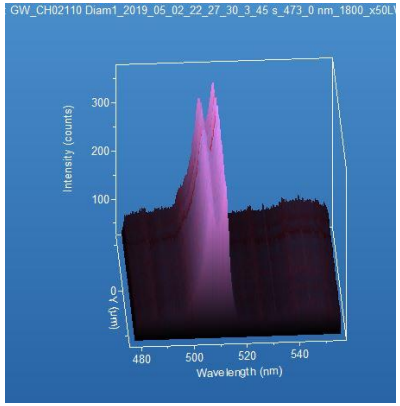
**Beam windows for high-power accelerator applications. Suspended graphenic membrane beam windows for next generation accelerators**

Continuation of activities in task 17.5. on materials for broader accelerator applications

Objectives:

- Production of innovative materials suitable for beam-windows applications in high power accelerators
- Particle transport and thermomechanical simulations for beam windows under high intensity operation conditions
- Characterisation of beam windows materials under thermomechanical load and extended radiation damage and their integration in accelerator environment
- **Participants**: CERN, GSI, WWU Münster, RHP
- **EC contribution: 100 k€ / Duration: 32 months**

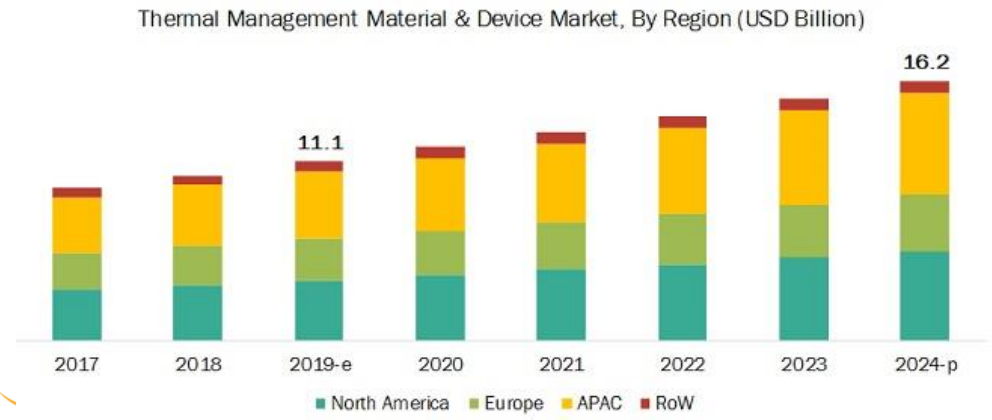
**graphenic membrane**




**Raman spectra of graphenic membrane**

# What's next - IFAST – WP4.4

- **IFAST WP4.4 – "Large scale Carbide-Carbon Materials for multipurpose applications"** naturally follows the R&D and industrialization phases for the carbide-carbon materials.
- Aim is to **decrease the production costs** to broaden the industrial use, by two methods:
  - **Increase the dimension of the sintered blankets** (less cycles needed to sinter a given volume of material)
  - **Decrease the sintering temperature** of the composite, tailoring the base composition (less power and duration of each cycle)
- **Participants**: CERN, Nanoker (ES)
- **EC contribution: 120 k€ / Duration: 4 years**


# Overview and Outlook

- Significant progresses in materials development, characterization, testing, and simulation in all WP tasks.
- ARIES greatly contributed to have some of these materials qualified, produced in series and installed in HL-LHC Collimators for LS2.
- All deliverable and MS achieved so far. Substantial outreach, including articles, theses and workshops.
- WP activity continuing (at smaller scale) as tasks 3 and 4 in WP4 of I-FAST
- COVID-19 pandemic has jeopardized a number of activities planned for end of year and year 4:
  - Additional TNA irradiation experiment at GSI
  - Dynamic characterization of materials in POLITO with new high temperature set-up
  - Preparation of first high power laser beam experiments at ELI-NP
  - Dissemination activities through joint workshop with WP6
- **Strategy and planning for next WP17 activities to be discussed at this meeting, taking a possible extension of 6 to 12 months into account …**

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# Thank you for the attention, and let's have a productive meeting!