



1st Workshop of ARIES WP17 (PowerMat): Outcome, Actions, Deliverables

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ARIES WP17 PowerMat

- Thanks to Polito and particularly to Lorenzo and Martina for organizing this workshop in such an inspiring and beautiful location



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

Milestones

Milestone number¹⁸	Milestone title	WP number⁹	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 Number¹⁴	Deliverable Title	Lead beneficiary	Type¹⁵	Dissemination level¹⁶	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

Deliverables and Milestones

Task	Year 1				Year 2				Year 3				Year 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
17.1		M														
17.2				D										M		
17.3									M			M				D
17.4														D		
17.5																M
1.4								D								

ARIES WP17 PowerMat: Workshop goals

- The main goals of this workshop are:
 - Define the WP work program for the next 6 – 12 months, including Deliverables and Milestones
 - Foster discussions, exchanges and collaboration between partners
 - Prepare the list of experiments, sampling, testing and characterization campaigns
 - Define next steps and meetings, e.g. annual meeting (ARIES annual meeting in Riga, LV, 22-25 May '18)
- **You should not leave this event unless you clearly know what you should do in the next 6 – 12 months!**
- **So let's start And enjoy the Workshop**

Task 17.1 - Actions

- WP Annual Meeting: one day at Riga ARIES meeting (Tuesday 22/5 or Friday 25/5)?

There is a general consensus that we should profit of this opportunity with for at least the participation of all task leaders. Date be discussed soon (**December. M. Tomut; A. Bertarelli**).

- **Deliverable 17.1:** what to put in, what not (e.g MultiMat)?

All the participants agree to include the characterization of non-irradiated materials (CERN: thermomechanical, UHV, microstructure; GSI: Raman Spectroscopy, thermomechanical; POLITO: dynamic characterization; POLIMI: coating characterization). Results of tests with beam should be included in a different document. Internal deliverable: **March, 2018. All.**

- **Deliverable 17.2:**

First ideas to put irradiation tests, but also mechanical characterization.

- Two PhD thesis developed in the scope of EUCARD/ARIES were discussed (F. Carra, E. Quaranta).

F. Carra asked for a publication of a monograph, waiting for the answer of V. Brunner. **F. Carra**

Task 17.1 - Actions

- Trans National Access

Organize/verify TNA for participation to HRMT experiments (MultiMat, FlexMat).

Who: CERN/GSI (**ASAP. M. Pasquali**)

- Outreach activities

- Workshop on HiRadMat potential + Advanced simulations and advanced materials. To be discussed (first contacts with Fiona in December '17)

- Special Issue on specialized journal on compilation of HiRadMat tests (including MME and STI), including theoretical and numerical predictions and instrumentation methods.

Available journals (e.g. Dynamic Behavior of Materials) to be checked (**Early '18. L. Peroni**)

- Article on the workshop to be submitted by December, 5th for the Accelerating News issue scheduled on December, 15th (**C. Accettura, A. Bertarelli**)

Task 17.2 / 14.4 - Actions

Task 2: Materials development and characterization
(A. Bertarelli – CERN)

Task 14.4: Industries for resistant materials
(F. Carra– CERN)

- Produce MoGr material samples with different graphite types (Large flakes first).
When: **after Christmas**. Who: **CERN, BB**. How many? CERN, BB to define.
Not for the deliverable.
- Complete characterization of all the material used for MultiMat for the DEL 17.1. The schedule of the deliverable must start in January (**CERN, GSI, POLITO**)
- Thermomechanical characterization of metallic thin films.
When: **in time for DEL 17.1**. Who: **POLIMI. M. Beghi, E. Besozzi**.
Availability of samples to be checked (**C. Accettura**)

Task 17.2 / 14.4 - Actions

- Non-disclosure agreement for all the materials to include in DEL17.1 must be checked (**CERN. J. Guardia**)
- Temperature-dependent mechanical flexural characterization of MG, CFC, Graphite, CuCD.
Who: **CERN, BB, RHP**. When: **Springtime, to be available in summer.**
- Dynamic Characterization of Carbide – Graphite
Who: **Polito, CERN, BB, RHP**. Materials to be delivered in January, tested in February. Results publication in DEL 17.1 to be decided.
Shape for CuCD test to be confirmed (**F. Carra, L. Peroni, M. Scarpin**)
- Fracture Mechanics characterization and NDT before tests.
Given the brittle nature of carbonaceous materials, it is agreed that LEFM approach should be investigated. Optimal geometries and testing method should be investigated first.
Who: **Polito, CERN, GSI**. When: **early 2018**
- Possibility to have NDT before mechanical tests should be investigated.
Who: **CERN**

Task 17.3 - Actions

Task 3: Dynamic testing and online monitoring (L. Peroni – POLITO)

- GSI irradiation experiment (CERN TNA).
Possible beam availability in **September, 2018** with Ca beam.
FLUKA results to chose beam parameters. **A. Lechner. Early '18.**
Details of the irradiation to be discussed in December, 2018 at WP14 meeting.
M. Tomut, A. Bertarelli, C. Accettura, J. Guardia, M. Beghi, A. Lechner
- Starting fracture Mechanics characterization (see task 17.2)
- Simulations of HiRadMat experiments.
M. Pasquali, C. Fichera, M. Portelli to start simulations in **December.**
FLUKA maps update (**A. Lechner, M. Frankl**) by **end of December, 2017**

Task 17.3 - Actions

- Preparation of FlexMAT experiments.
Possible time: **end of May/June** to be checked (**M. Tomut**).
CERN to help GSI and POLITO with simulations (**FLUKA team**).
Instrumentation set-up to be discussed in December (**M. Tomut, M. Guinchard**).
The experiment could be included in the special issue on HiRadMat experiments.
- Impact tests on carbon based material at high temperature in vacuum.
In 2-3 months at Polito. L. Peroni, M. Guinchard

Task 17.4 - Actions

Task 4: Simulation of irradiation effects and mitigation methods (A. Lechner – CERN)

- Update of FLUKA calculations quantifying the long-term radiation damage in HL-LHC collimators (including new loss scalings, extended to coatings, and covering also gas production) - **CERN**
- Definition of the requirements for the GSI irradiation campaign of CERN samples in 2018 (ion species, fluence requirements, equivalence with damage in LHC collimators) - **GSI, CERN**
- Discussions on co-operation with RaDIATE collaboration concerning coated examples to be irradiated in 2018 BLIP run (concerning DPA calculations, PIE etc.) - **CERN, POLIMI**
- Support to HiRadMat experiments in terms of energy deposition studies (e.g. MultiMat) - **CERN**

Task 17.4 - Actions

- Support for DPA calculations for irradiated GSI samples (diamonds etc.) - GSI, CERN
- **Medium-term activities:**
- Extend DPA, gas production studies to other devices devices/machines
 - FLAIR beam dumps/catchers - **GSI with guidance from CERN**
 - FCC collimators, FCC dump, HL-LHC dump, HE-LHC - **GSI CERN**

Task 17.5 - Actions

Task 5: Broader accelerator and societal applications (M. Tomut – GSI)

- Optimize metal matrix for better response to fast extracted heavy ion beams – ongoing. **GSI with RHP**
- Optimize diamond particle sizes and distribution for different applications – to be started. **RHP-GSI**
- Optimize color centers in diamond for different applications (luminescence screens, QD's and medical imaging) - using different doping recipe. **GSI, collaboration LBNL**
- Workshop with technology transfer on applications of new materials for advanced engineering solutions, efficient energy solutions, space, thermal management.
Long-term project, but some proposals for the next meeting in Riga (**All**).