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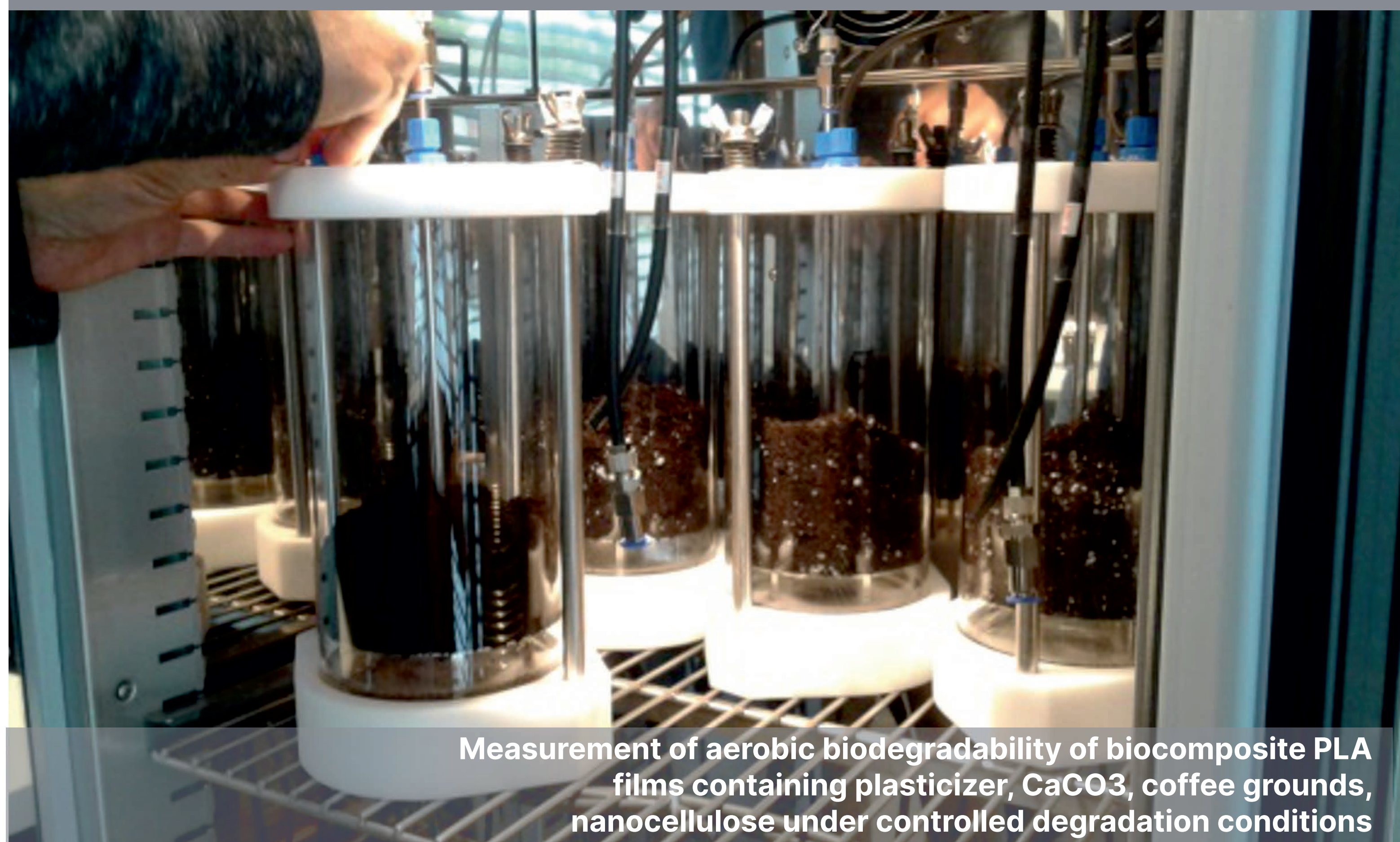


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# HY Hi

## RESEARCH PROGRAMME 2 COMPOSITE MATERIALS AND STRUCTURES

### RESEARCH ACTIVITY 1: COMPOSITES AND NANOCOMPOSITES WITH BIODEGRADABLE MATRIX



Measurement of aerobic biodegradability of biocomposite PLA films containing plasticizer, CaCO<sub>3</sub>, coffee grounds, nanocellulose under controlled degradation conditions

## OBJECTIVES

Design, preparation and production of a biodegradable composite system with nanostructured elements, possibly hierarchical structures and nanostructures. The resulting composite system has specific properties including biodegradability.

### Activities:

- selection of biodegradable matrix, fillers, nanofillers and hierarchical structures and nanostructures;
- preparation of the composite system;
- evaluation of the properties of the biodegradable composite;
- verification of the material composition in terms of matrix and type of fillers and structures for application possibilities in selected applications.

## RESULTS AND OUTPUTS

Within the research activity, journal, applied and other results were produced, which cover a wide area of the problem from material research, through the evaluation of selected properties and degradability to functional samples and research reports.

- 15 Jimp type results
- 5 D type results
- 2 international PCT patent applications
- 1 registered Czech patent
- 2 registered utility models
- 2 functional samples
- 4 research reports
- 1 manufacturing technology
- 4 databases.



Fracture surface of biocomposite structural system with PLA matrix reinforced with 3D knitted fabric



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# HY RESEARCH PROGRAMME 2 COMPOSITE MATERIALS AND STRUCTURES

## HI RESEARCH ACTIVITY 2: COMPOSITES WITH ELASTOMER MATRIX

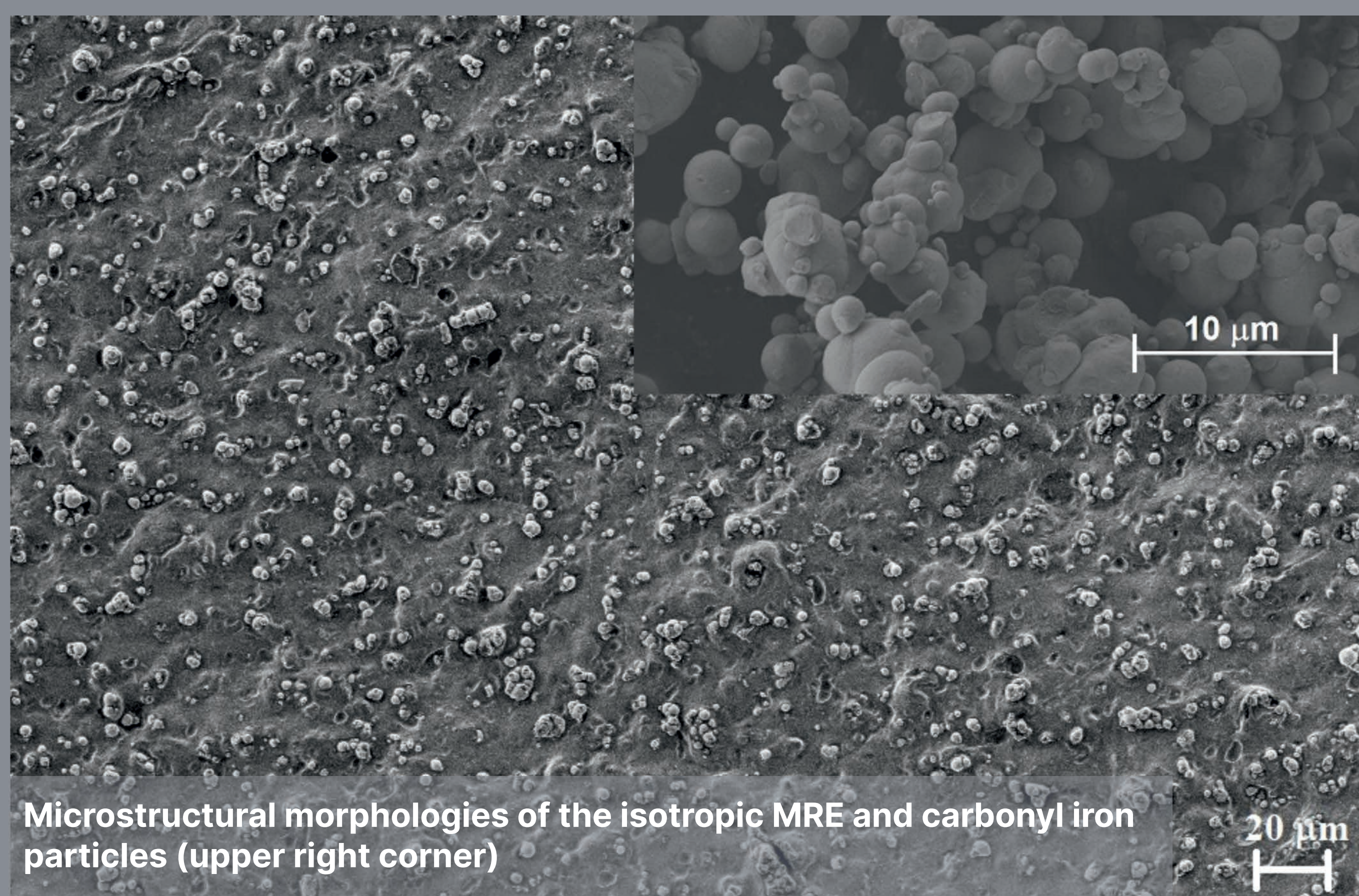
### OBJECTIVES

Development of suitable experimental methods enabling determination of thermo-mechanical and magneto-mechanical properties of MRE composite systems.

Experimental measurement of the mechanical, thermal and magnetorheological behavior of MRE composites of a simple shape under quasi-static and dynamic loading.

Compilation of mathematical models representing the anisotropic, nonlinear and inelastic behavior of elastomeric composites.

Description of the dynamic behavior of passive damping elements from MRE composite systems.



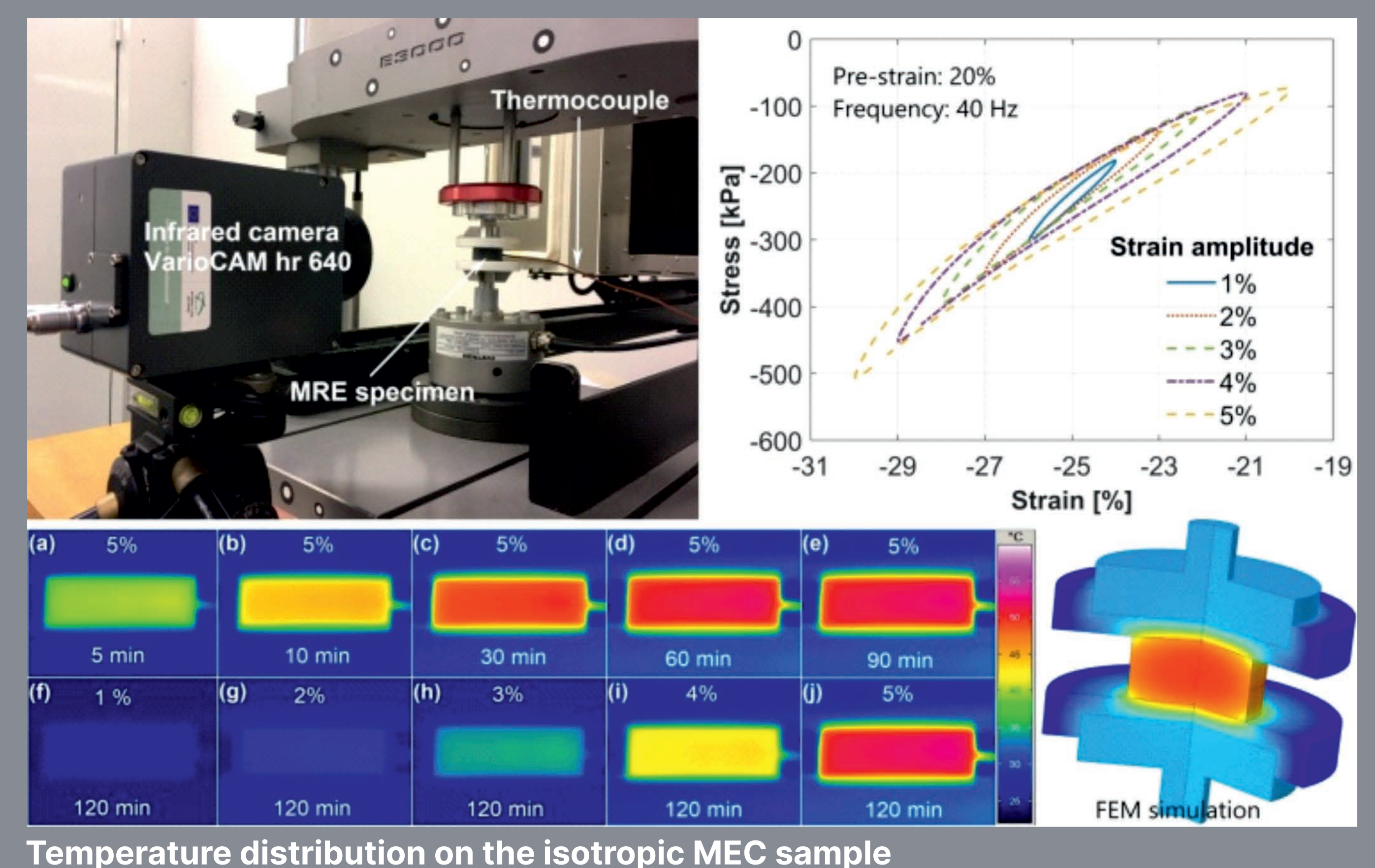
### RESULTS AND OUTPUTS

Notable Publications: Nam, T. H., Petříková, I., Marvalová, B., & Hdaib, M. Y. (2021). Self-heating and dynamic mechanical behavior of silicone rubber composite filled with carbonyl iron particles under cyclic compressive loading. *Journal of Composite Materials*, 55(28), 4273-4292.

Investigation of energy dissipation and self-heating of magnetorheological elastomers (MRE) of silicon rubber filled with carbonyl iron microparticles under long-term cyclic pressure loading.

#### Other Results

- Research reports
- Publication with IF in Q1/Q2
- Significant contributions at international conferences.





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# HY RESEARCH PROGRAMME 2 COMPOSITE MATERIALS AND STRUCTURES

## HI RESEARCH ACTIVITY 3: CELLULAR LIGHT METAL STRUCTURES

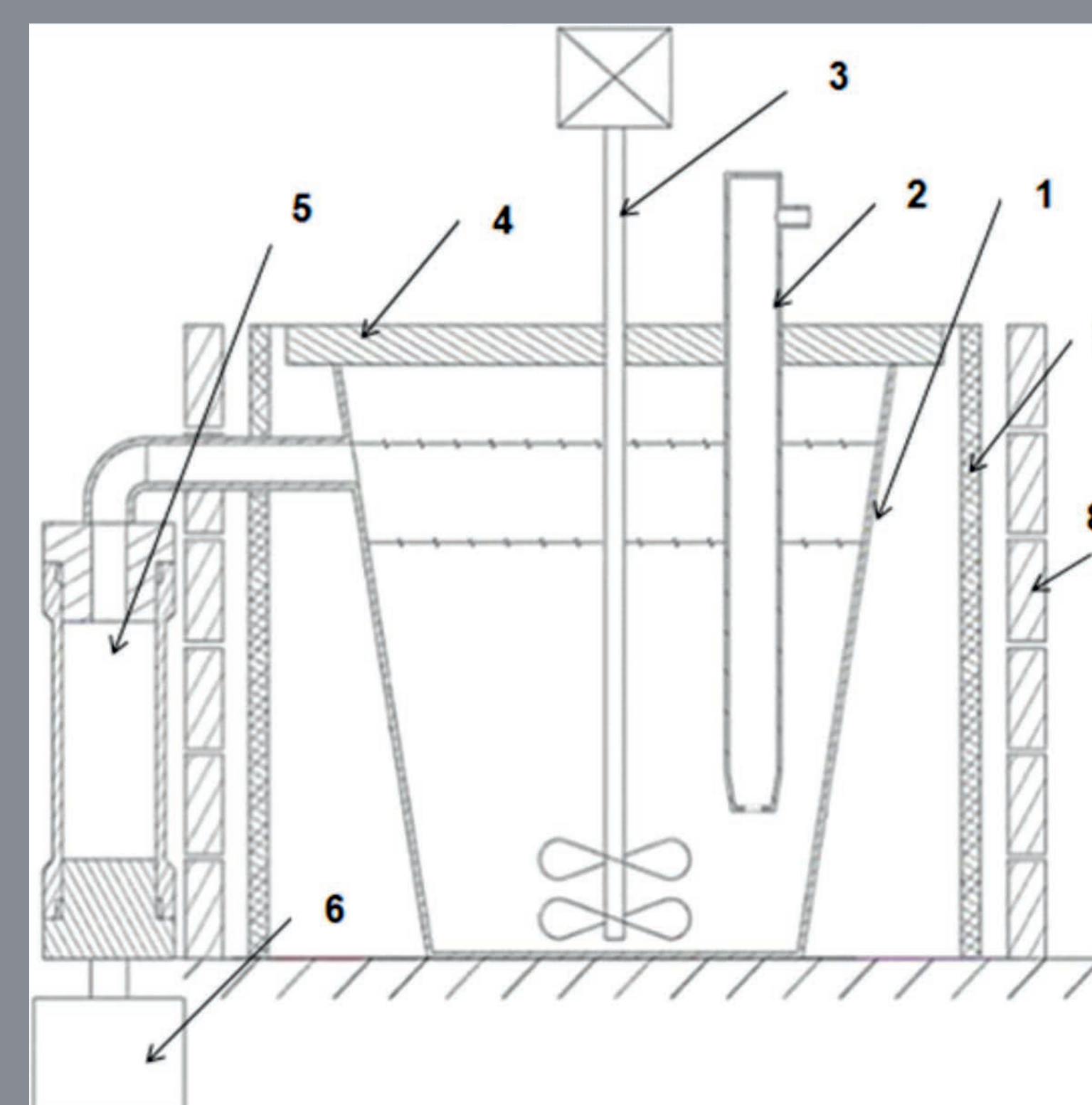
### OBJECTIVES

#### Theoretical-experimental study

- Construction of experimental equipment and monitoring of the process of two-phase flow of foaming liquids with gases
- Different foaming intensities and different liquid parameters were tested.
- Theoretical calculations of the two-f simulation flow (VOF).

#### Practical (application) study

- The methodology for the production of metal cellular systems, porous metal systems using water-soluble salt cores was designed and tested.
- Investigation of the solubility and diffusion of hydrogen in pure aluminum.
- Prototype construction - Equipment for the production of cellular metal structures.



Equipment for the preparation of metal foams

- 1 – foaming cup with melt;
- 2 – capillary tube for gas supply;
- 3 – stirrer;
- 4 – cup cover with holes;
- 5 – foaming foundry mould;
- 6 – vacuum pump;
- 7 – insulating material;
- 8 – electromagnetic coils

### RESULTS AND OUTPUTS

**Patent:** Fraňa, Nová, Koreček, Hujer and Svoboda, Method and device for preparing metallic foam, PCT CZ2021/050138.

The invention relates to a method for the preparation of metal foam, in which a metal melt containing up to 25% by volume of at least one stabilizer is mixed, while a gas is injected into it, which bubbles through it and foams it, thereby creating a foamed metal melt, which after solidification creates metal foam.

#### Other Results

- Research reports
- Catalog of materials
- Publication with IF in Q1/Q2 and Q3
- International project - submitted



Foaming furnace HTM Reetz GmbH



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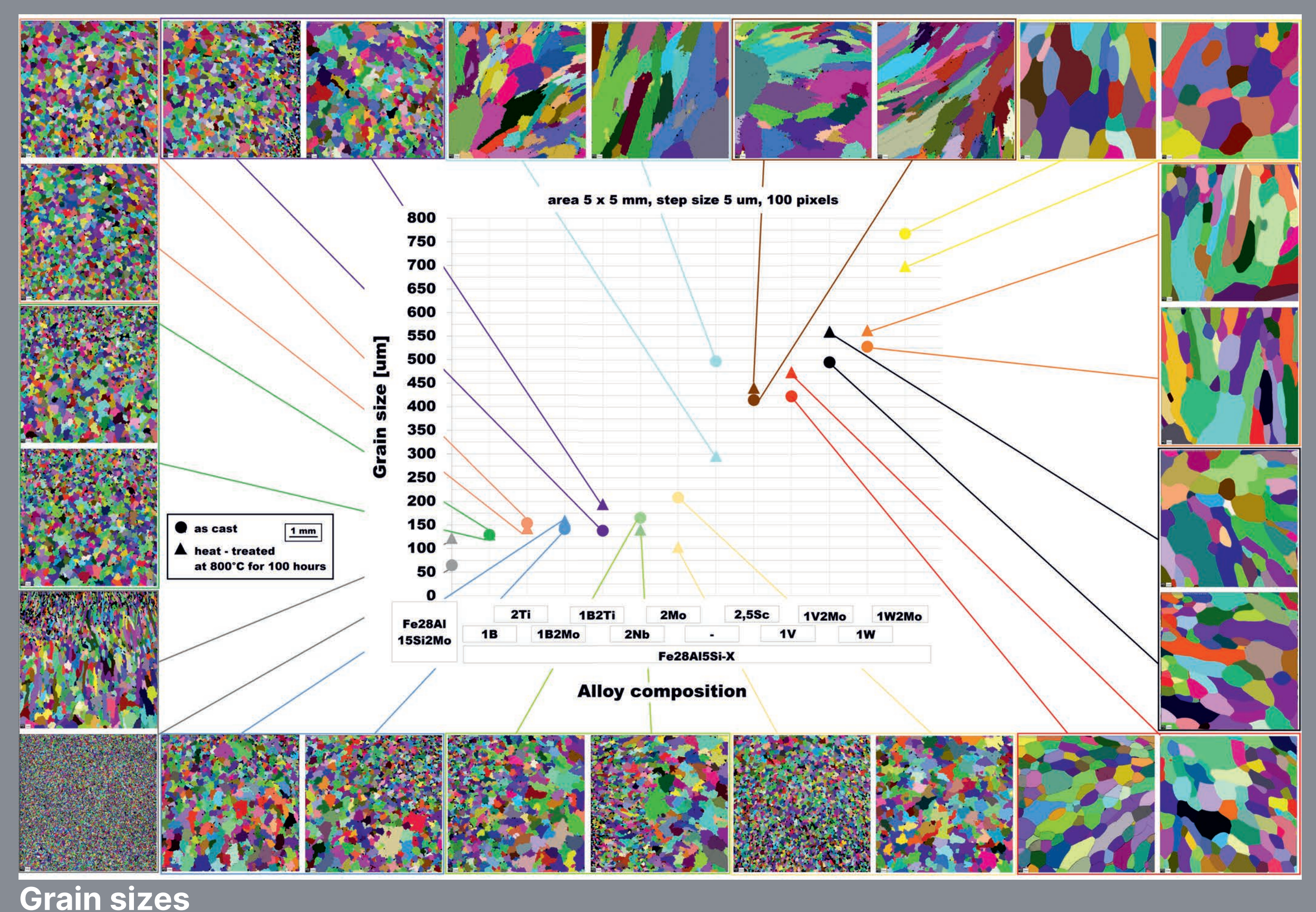
## Hi RESEARCH ACTIVITY 4: SUBSTITUTE MATERIALS PRO HIGH TEMPERATURE APPLICATIONS

### OBJECTIVES

The development of intermetallic Fe-Al-Si-X alloys for high-temperature application, the improvement of mechanical properties by microalloying, and by heat treatment.

#### Activities

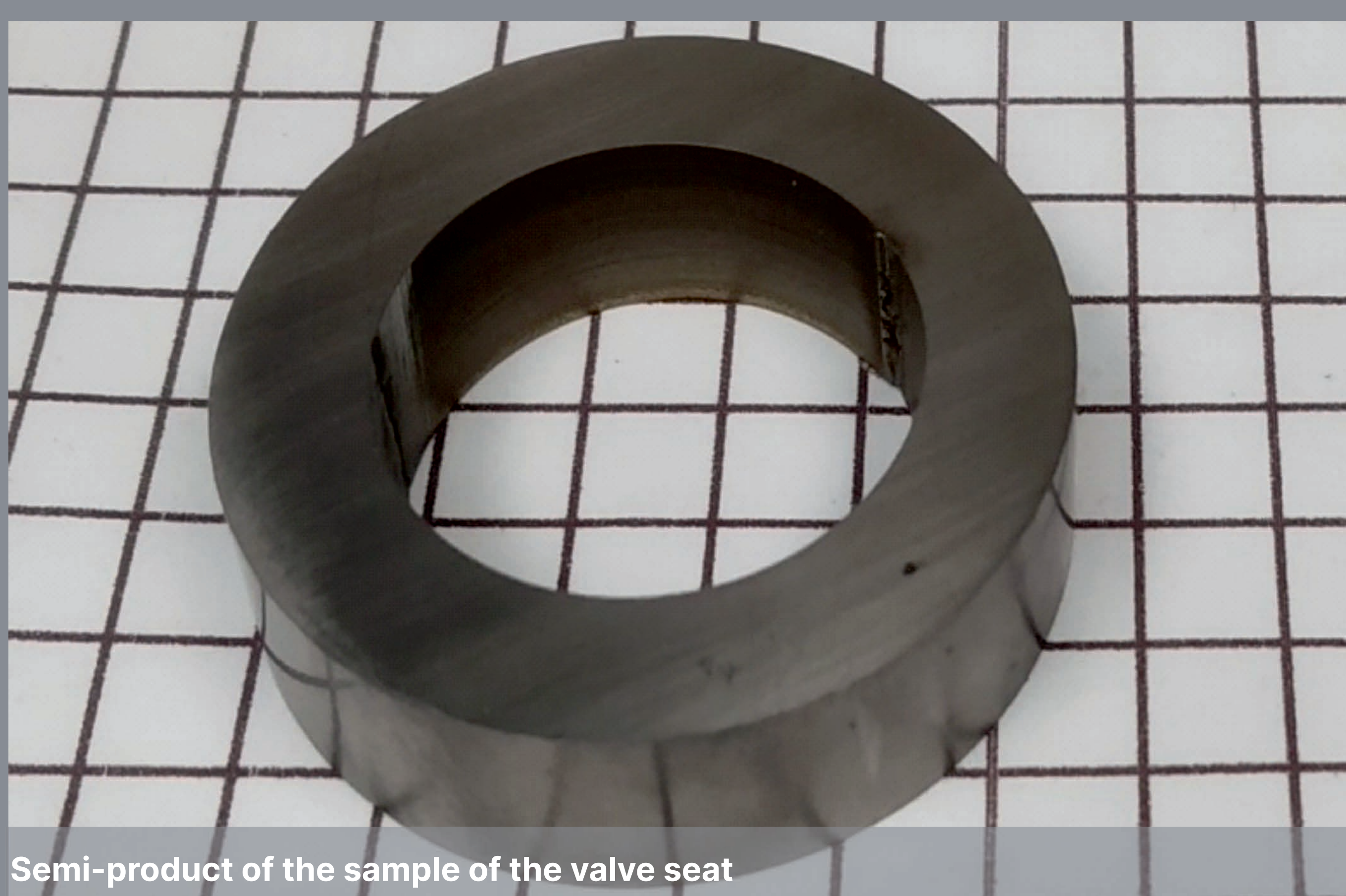
- Design and preparation of several sets of alloys with defined chemical composition.
- Metallographic samples preparation of alloys after casting and heat treatment.
- Structure investigation by light optical microscopy and scanning electron microscopy with the use of analytical methods for chemical and phase composition determination.
- Tests of physical properties such as diffusivity, thermal conductivity, and thermal capacity.
- Tests of high-temperature mechanical properties - compression tests, dilatation tests.



Grain sizes

### RESULTS AND OUTPUTS

- **PCT patent** application (Ref.: PV 2021-200/D21038868/2021/ÚPV) with the title: "Alloy based on Fe-Al-Si-X" or "Fe-Al-Si-X-based alloy and its use".
- 8 Jimp papers
- Submitted H2020 project proposal
- Functional sample
- 4 Research reports
- Catalogue of materials.



Semi-product of the sample of the valve seat

