

PN-III-P2-2.1-PED-2021-1827 contract no. 576 PED/2022

## **Project Title**

***Advanced medical systems for boron-capture enhanced proton therapy (AMSBPCEPT)***

Contractor: University "Politehnica" of Bucharest (UPB)

Director: Prof. dr. eng. Daniela-Cristina Berger

Email: daniela.berger@upb.ro

Partner: "Horia Hulubei" National Institute for Research and Development in Physics and Nuclear Engineering (IFIN-HH)

Scientific Responsible: CSI Dr. Diana-Iulia Savu

## **Project scope**

The aim of the project is proof-of-concept technology (TRL4) for obtaining advanced systems containing mesoporous silica functionalized with boronic acid derivative loaded with an antitumoral agent for boron proton-capture enhanced proton therapy (BPCEPT that integrates multiple functionalities): carrier for an antitumoral compound–functionalized mesoporous silica nanoparticles, targeting the tumoral tissue due to the presence of boronic acid groups, presence of moieties containing boron for  $^{11}\text{B}$  proton capture therapy, and the delivery of the antitumoral compound into tumoral tissue triggered by protons beam irradiation.

**Project duration (in months)** – 24 months

**Project start date:** 24 June 2022

**Project end date:** 23 June 2024

Total budget: 598795 lei

Public budget: 598795 lei

Own budget: 0 lei

Budget for UPB: 299398 lei

Budget for IFIN-HH: 299397 lei

## **Project team - UPB**

Director Prof. Daniela-Cristina Berger

Assoc. Prof. Mona Mihailescu

Prof. Cristian Matei

CSIII Mihaela Deaconu

PhD Ana-Maria Brezoiu

PhD student Simona Ioniță

PhD student Daniel Lincu

PhD student Nicolae Tarbă

CSI Eugeniu Vasile

## **Project team – IFIN-HH**

Scientific Responsible – Dr. Diana Iulia Savu

CSIII Dr. Roxana-Cristina Popescu

Drd. Mihaela Temelie

CSI Liviu Stefan Craciun

Drd. Mihaela Tudor

### **Abstract**

The project, Advanced medical systems for boron-capture enhanced proton therapy (AMSBPCET), is complex interdisciplinary research that integrates the expertise of chemical engineers, physicists, and biologists from three research groups, two from University "Politehnica" of Bucharest and one from Horia Hulubei National Institute for R&D in Physics and Nuclear Engineering. The scope of the project is proof-of-concept technology (TRL4) for obtaining advanced systems containing mesoporous silica functionalized with boronic acid (MSN-B) loaded with an antitumoral agent (At) for boron proton-capture enhanced proton therapy (BPCEPT) that integrates multiple functionalities: carrier for an antitumoral compound—MSN-B, targeting the tumoral tissue due to the presence of boronic acid groups, presence of moieties containing boron for  $^{11}\text{B}$  proton capture therapy, and the delivery of the antitumoral compound into tumoral tissue triggered by protons beam irradiation. The novelty of this project consists in using for the first-time mesoporous silica functionalized with boronic acid as nanocarrier for an anticancer agent for combining boron proton-capture therapy with chemotherapy for an enhanced effectiveness of the cancer treatment. 6 objectives have been identified for fulfilling the project aim: *(i)* obtaining of MSN-B with particles size lower than 100 nm for targeting and accumulation into tumoral tissue; *(ii)* loading of MSN-B with an antitumoral agent (MSN-B-At); *(iii)* assessment of the cytotoxicity of MSN-B and MSN-B-At by highlighting the main endocytotic mechanisms involved in nanoparticles uptake; *(iv)* evaluation of MSN-B and MSN-B-At for BPCEPT; *(v)* assessment of MSN-B and MSN-B-At internalization by hyperspectral microscopy; *(vi)* demonstration at laboratory scale the functionality of developed MSN-B-At systems for BPCEPT.

### **Estimated results**

- 2 papers in ISI journals
- at least 4 presentations at international conferences
- 1 patent application
- 2 advanced systems containing mesoporous silica nanoparticles functionalized with boronic acid derivatives loaded with a cytostatic acid or a natural compound with antitumoral activity