The possibility of using 3D printing technology in research on BNCT

Edyta Michaś , Anna Talarowska, Katarzyna Tymińska, Michał Dorosz, Maciej Maciak, Michał A. Gryziński

National Centre for Nuclear Research, Otwock-Świerk, Poland

E-mail: edyta.michas@ncbj.gov.pl

History of 3D printing began in 1980s as an additive manufacturing technique. By using various techniques and materials it has influenced the affordability of 3 dimension models in many areas from industry through research to everyday life. Five main 3D printing methods have been distinguished: Stereolithography (SLA), Inkjet Printing, Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), Laminated Object Manufacturing (LOM). In our study we focused on FDM method, because it is the one mostly used in research. Just like in all methods, we start with the implementation of three-dimensional model, made using CAD software and exported to the .STL file format. In second step the file is uploaded to the printer and the printing process begins. Next the thermoplastic polymer is heated in the nozzle of printer to touch the table. Afterwards the actual printing phase takes place layer by layer using a filament in the semi-liquid phase, which in room temperature becomes hardened [1].

Over 30 years of development, 3D printing technology has led to a revolution in the world of new technologies in many fields of science, in medicine alone it is oncology and transplantology. In oncology 3D printing technology is useful for conventional radiotherapy or proton therapy, in transplantology it is used for printing an organ prototype, in preclinical studies for organ-on-a-chip constructions [2].

Station dedicated to research on Boron Neutron Capture Therapy, being under construction at National Centre for Nuclear Research in Poland, will use the beam from the horizontal channel. This forced the search for a solution that would allow vertical irradiation of cell lines during pre-clinical studies. Then the idea came to use 3D printing technology for this purpose. This technology will allow to make low-cost holders dedicated to a given type of culture vessel.

The research on the grip started by performing a Monte Carlo simulation of different layers thickness of the main component of the filament printer in the neutron beam with the stream used for biological tests. We decided to take one centimeter as the maximum material thickness. In next step, the holder with a given thickness was designed and printed to check its mechanical strength. Due to the fact that producers of commercially available printer materials do not provide exact composition, an activation analysis of the majority of available types of materials was carried out at MARIA research reactor in order to select the best one.

On the basis of the results obtained, in the presentation, I will answer the question whether it is possible to use 3D printing for research on BNCT.

References

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