

**Doctoral School of Information and Biomedical Technologies**  
**Polish Academy of Sciences (TIB PAN)**

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**SUBJECT:** Stimuli-responsive drug delivery systems activated by light.

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**DESCRIPTION:** A biomaterial is defined as a substance, other than drugs, synthetic or natural, which can be used for any period of time, which augments or replaces partially or totally any tissue, organ or function of the body. The biological activities within the human body are varied, complex and dependent on several factors, therefore biological processes related to one single tissue are changing over time. Scientists have been trying to mimic the multifunctional behavior of natural biological structures for the last few years. In order to overcome these issues, a novel class of materials called smart biomaterials is being developed [1].

Smart biomaterials are generally defined as biomaterials, which demonstrate a special behavior when an external stimulus is applied. Smart biomaterials show improved properties compared to traditional ones because their properties can be modulated applying external stimuli [2]. The development of smart biomaterials represents another step forward towards the realization of fully biomimetic materials and the production of materials with different properties that can be easily tuned and changed according to the needs of the biological tissue at a specific time. Smart biomaterials are extremely attractive, especially for drug delivery applications [3].

Light-responsive materials became very attractive since it is possible to design and fabricate biomaterials that show high absorption in the NIR region (wavelength: 700-1100 nm), which is a biological tissue-transparent radiation and can penetrate living tissues without causing damage [4]. Most importantly, the light absorbed by these nanomaterials can rapidly be converted into heat, which opens the way for novel on-demand biomedical applications as the possibility to release drugs on demand [5]. The combination of these properties makes them suitable for the development of systems able to release different drugs in the targeted tissue at the same time.

The PhD project is directed towards developing a new type of smart nanostructured drug delivery system capable of delivery and different types of bioactive molecules (e.g. anti-inflammatory drug as well as microRNA for inflammatory response regulation) in specific tissues and at a well-defined time upon NIR light irradiation. It is expected that a large number of articles will be published in international scientific journals with high impact factor.

**BIBLIOGRAPHY:**

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- [5] M. Liu et al., "Injectable Thermoresponsive Hydrogel Formed by Alginate-g-Poly(N-isopropylacrylamide) That Releases Doxorubicin-Encapsulated Micelles as a Smart Drug Delivery System", *ACS Appl. Mater. Interfaces*, 9, 35673-35682, 2017.