

## **Photoactive Hydrogel-Based Therapy for Disrupting Biofilms in Chronic Wound Infections**

**Wanessa CMA Melo\***

State Research Institute Center for Physical Sciences and Technology (FTMC), Department of Functional Materials and Electronics, Vilnius, Lithuania

**Eglė Žalytė**

State Research Institute Center for Physical Sciences and Technology (FTMC), Department of Functional Materials and Electronics, Vilnius, Lithuania

**Adei Abouhagger**

State Research Institute Center for Physical Sciences and Technology (FTMC), Department of Functional Materials and Electronics, Vilnius, Lithuania

**Arunas Stirke**

State Research Institute Center for Physical Sciences and Technology (FTMC), Department of Functional Materials and Electronics, Vilnius, Lithuania

### **Abstract:**

This study introduces a novel photoactive hydrogel (HGIMBI) incorporating methylene blue (MB) as a photosensitizer for the treatment of chronic biofilm-related infections. The innovation lies in the gel-like formulation of HGIMBI, which enhances MB penetration into biofilms, enabling deeper and more effective disruption of the biofilm matrix. By improving interaction with the biofilm's extracellular polymeric substances (EPS), HGIMBI facilitates EPS reduction and structural degradation of the biofilm. Upon light activation, the hydrogel generates reactive oxygen species (ROS), significantly boosting its antimicrobial activity. HGIMBI exhibited broad-spectrum efficacy against both bacterial and fungal biofilms, including *Candida albicans*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*. Importantly, it demonstrated low cytotoxicity toward fibroblast cells, making it a safer and more targeted alternative to conventional antimicrobial treatments. These findings underscore the potential of HGIMBI to overcome biofilm-associated resistance mechanisms and improve outcomes in chronic wound management.

### **Keywords:**

*Candida albicans*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, methylene blue, photoactive hydrogel