ECM 2025 Conference

The 3rd International Electronic Conference on Microbiology

01–03 April 2025 | Online

MDPI

An innovative electrochemical nanogenosensor for the detection of *Candida* species

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INTRODUCTION & AIM

Nevertheless, significant advancements in the prevention and treatment of fungal infections, invasive fungi like *Candida* species remain the major cause of morbidity and mortality worldwide [1]. In fact, the Global Action Fund for Fungal Infections estimates that each year, almost 300 million individuals contract a fungal infection, and over 1.5 million of them died as a result [1,2]. *Candida* can enter the bloodstream and spread to internal organs, but it can also commonly cause surface infections, like those in the skin or mucous membranes, which can be readily and effectively treated [3]. This fungal infection has been observed in high-risk patients, such as those receiving allogeneic stem-cell transplants and those receiving high-dose chemotherapy for acute leukemia [4]. These patients are more vulnerable to infections since their immune systems are weakened during the transplant process. Systemic fungal infections are still difficult to diagnose. Therefore, developing early diagnosis methods that are more precise, sensitive, and effective is required. A quick, easy, and accurate method for identifying fungal infections in patients following hematopoietic stem cell transplantation (HSCT) was devised in this study. To overcome this problem, an electrochemical nanogenosensor for the detection of *Candida albicans* was developed. This nanogenosensor was assembled in an innovative low-cost electrochemical paper-based analytical device (ePAD) (Figure 1). The application in a hospital context will be covered in future studies in terms of sensitivity, accuracy, response time, issues, and potential.

METHOD

Design of ePAD

ePADs are a substitute technology to produce inexpensive, disposable analytical instruments. By including a working electrode and a counter-reference electrode, the ePAD design will encompass the structure of an electrochemical cell (figure 1). Conductive inks must be deposited on the paper network to create conductive electrodes by inkjet printing in order to fabricate devices on paper.

Steps for the construction of the nanogenosensor

Briefly, the electrochemical nanogenosensor construction involved four steps (figure 2):

1. Covalent immobilization of thiolated DNA capture probes (SH-DNA) (figure 3);
2. Gold surface modification *via* binary self-assembled monolayers (SAM), usually: 6-mercapto-1-hexanol (MCH);
3. Hybridization of complementary format assay with enzymatic labels;
4. Electrochemical hybridization signal detection by chronoamperometry.

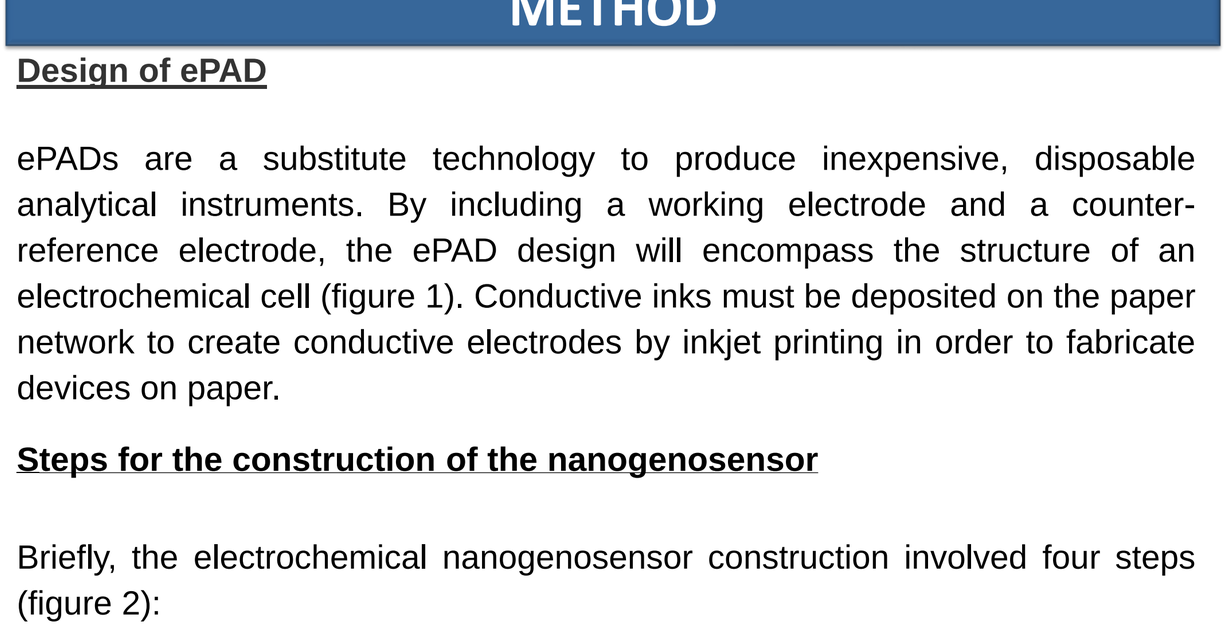

Figure 1: A simple design (draft) and generic scheme for the ePAD circuit template.

Figure 2 : Develop of nanogenosensors designed to evaluate *Candida* spp.

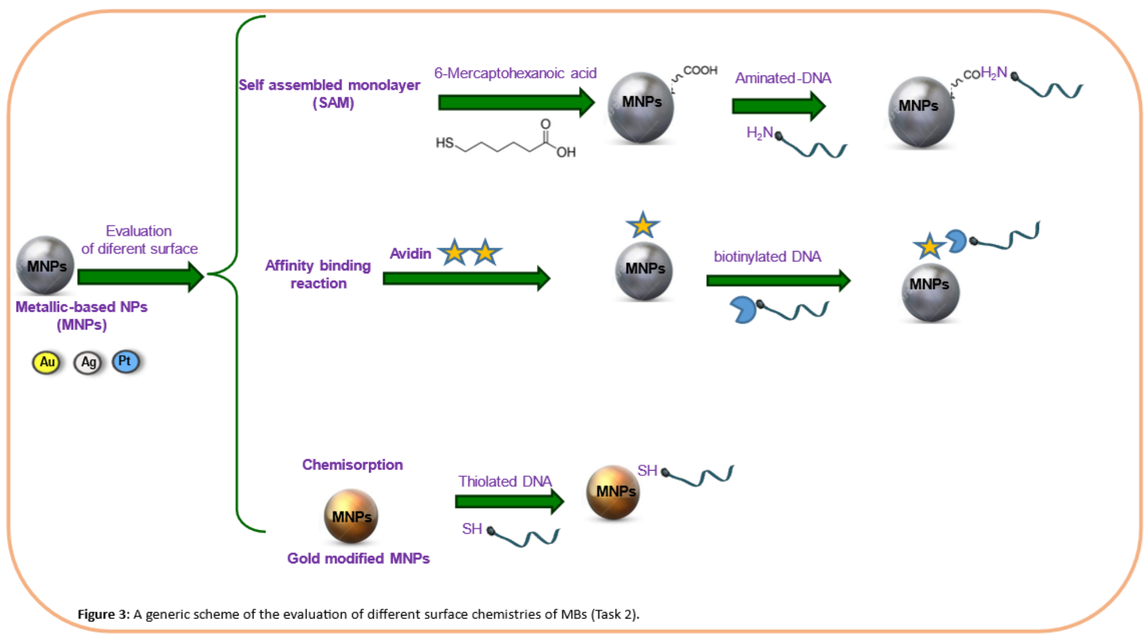

Figure 3: A generic scheme of the evaluation of different surface chemistries of MBs (Task 2).

RESULTS & CONCLUSION

Some types of surfaces for the sandwich reaction were evaluated; however, the study began with gold nanoparticles (figure 3). The thiol linkage of synthetic DNA to gold ensures strong adhesion, while the DNA can provide functionality for specific molecular interactions.

Initial results indicated that *Candida spp*. could be found in synthetic fungal samples by using these nanogenosensors. Although these findings, efforts are underway to optimize the nanobiosensor for measuring *Candida albicans*, a process that will be confirmed in subsequent research. Future developments will focus on the applicability in the hospital setting with respect to sensitivity, precision, response time, difficulties, and ability. Inexpensive paper transducers, or ePADs, are disposable analytical devices constructed from glossy cellulose paper and conductive inks (in optimization).

FUTURE WORK / REFERENCES

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