Click and Detect: Versatile Ampicillin Aptasensor Enabled by Click Chemistry on a Graphene–Alkyne Derivative

Martin-Alex Nalepa
José M. R. Flauzino, Michal Otyepka
Regional Centre of Advanced Technologies and Materials – Czech Advanced Technology and Research Institute (CATRIN), Palacký University Olomouc, Šlechtitelů 241/27, 779 00 Olomouc, Czech Republic
martinalex.nalepa01@upol.cz

Addressing the impending crisis of antimicrobial resistance (AMR), which poses significant dangers to global health, requires swift, economical, and efficient approaches for controlling and identifying antibiotics within diverse samples at the point of interest. Economical, disposable, electrochemical biosensors for point-of-care applications present an especially appealing solution. However, the demand persists for versatile and conductive carbon-based materials and inks that enable effective bioconjugation under mild conditions, thereby facilitating the creation of durable, sensitive, and selective devices. This work describes a straightforward and rapid methodology for constructing an aptasensor using a novel graphene derivative equipped with alkyne groups, synthesized via fluorographene chemistry. Through the utilization of click chemistry, an aptamer is immobilized and serves as a successful platform for the selective determination of ampicillin in real samples, even in the presence of interfering molecules. The electrochemical aptasensor exhibits a detection limit of 1.36 nM, exceptional selectivity among other antibiotics, the capability for storage over 4 weeks, and effectiveness in real samples. Additionally, structural and docking simulations of the aptamer illuminate the binding mechanism of ampicillin. The versatility of this platform opens up a wide range of possibilities for the design of a new category of aptasensors based on disposable screen-printed carbon electrodes usable in point-of-care devices.

Figures

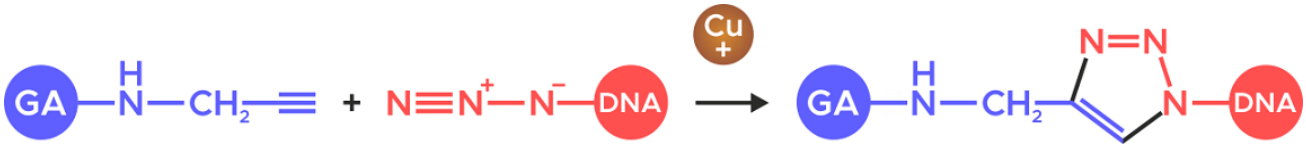

Figure 1: Reaction scheme depicting click chemistry between GA-NH-YN and a DNA aptamer bearing an azide moiety.