MOS KIT

TEAM PASTEUR PARIS

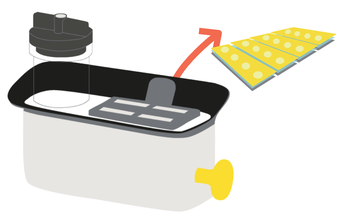
A CUSTOMIZABLE BIODETECTION SYSTEM

INTRODUCTION

Vector-borne (re)emerging diseases are responsible for severe epidemics worldwide, mosquito vectors causing 725,000 deaths worldwide annually (WHO). Vaccines or treatments are seldom available; thus, we resort to insecticides for vector control, resulting in insecticide-resistant mosquitoes and environmental damages. We have conceived a system, Mos(kit)o, composed of a mosquito trap, an analysis device that contains a biosynthetically produced patch allowing immuno-detection, and a mapping software.

OVERVIEW

1. Trapping system

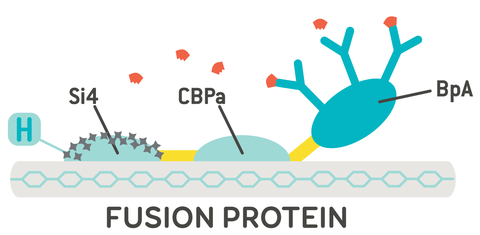


2. Detection kit with patch

3. Mapping software

SCIENCE METHODOLOGY

Construction of the Patch. It was assembled in three steps : designed as a fusion protein composed of the Si4-silification peptide (iGEM Leeds 2013), CBPa, the cellulose binding domain of Clostridium cellulovorans cellulose binding protein (iGEM Bielefeld_Germany 2012), and BPA (iGEM Warsaw 2008), the B-domain of protein A from Staphyloccocus aureus. The cellulose layer was pressure formed with crystalline cellulose powder, the fusion protein was expressed after cloning of the gene construct into a pET43.1a plasmid and expressed in E. coli Bl21De3 cells. Proteins were purified by FPLC on a polystyrene Ni-NTA column. The silification was performed using TEOS (Tetra ethyl orthosilicate) according to a method developed from iGEM Minnesota 2011. Testing for antigen binding was performed on PVDF membranes, using monoclonal antibodies against E2-YFV envelope proteins.

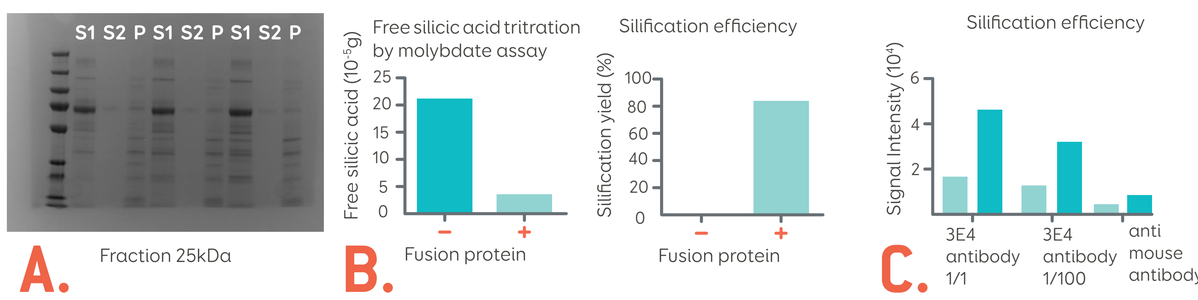


FUSION PROTEIN

DESIGN METHODOLOGY

All three parts of this system were designed in a way that is user-friendly so no scientific background is needed to use it. We paid special attention to safety issues, ergonomics, universal pictograms, materials, textures. All these details participate to create a good harmony between form and function.

RESULTS AND CONCLUSIONS



A. Cellulose-binding test for C2 protein After mixing of C2 fractions with cellulose, several washes were performed. Bound material analysed by SDS_PAGE. S1 : first supernatant. S2 : washing supernatant. P: cellulose-based pellet. B. Silification test for C2 protein (left) Determination of free silicic acid concentration by molybdate assay. (right) Silification efficiency, calculated from B.(left) C. Immunodetection of envelope protein of CHIKV within mosquito lysate Histogram showing quantification of the binding (Mean of 3 measurement).

Results : The C2 fusion protein (Si4-CBPa-BPa) is able to bind cellulose and catalyse the silification of TEOS. The binding of 3E4 monoclonal antibodies against E2 envelope protein has been demonstrated in mosquito lysate. The 3D model of the Trap, and analysis detection kit have been generated as well as the the interface for the mapping software.
Conclusion : Construction of 2 biobricks. Assembly and test of the multilayer biosilica cellulose detection patch. Generation of a Technomoral scenario for the application of the Mos(kit)o device. Construction of the 3D printed model of the devices for the trap and analysis station, and human interface to the database.

SELECTED HUMAN PRACTICES

We brought the synthetic biology debate and questions about arboviral detection to schools, experts, and to the streets: Taught high school classes through lab, games, and discussions // Created online surveys and handed out questionnaires to people // Elaborated technomoral and application scenarios: with SYNENERGENE, Rathenau Instituut //Exhibited the Mos(kit)o prototypes: biodesign “Festival vivant” 2016. // Attended Zika summit, and Young Researchers in Life Science 2016 scientific conferences // Challenged our ideas to experts: Dr. Anna-Bella Failloux (entomologist), Claudia Riegel (New Orleans Mosquito And Termite Control Board, Louisiana, USA)... // We wrote a report on open science and intellectual property.

TEAM MEMBERS

Authors: B. Béliard[1], H. Bouziri[2], M. Camman[1], L. Dehove[3], A. Delots[1], M. Dumay[4], C. Gestin-Vilion[5], G. Graves[3], C. Guillaume[3], C. Hamamouche[4], M. Hubert[2], L. Hunault[1], S. Ivanoff[1], V. Le Chevalier[5], V. Legros[6], V. Lépine[5], M. Lorin[7], M. Maletic[2], X. Montoy[3], M. Morel[7], P. Polston[8], T. Vialon[1], D. Gopaul[9] 1 Ecole Supérieure de Physique Chimie Industrielle 2 Université Pierre et Marie Curie 3 Ecole Nationale Supérieure de Création Industrielle 4 Ecole des Techniques Supérieures de Laboratoire 5 Faculté Jean Monnet, Saclay 6 Unité d’Epidémiologie et Physiopathologie des Virus Oncogènes, Institut Pasteur 7 Université Paris Diderot 8 Unité de Biologie des virus entériques, Institut Pasteur, NY, USA 9 Genomes and Genetics, Plasticity of the bacterial Genome , Institut Pasteur

ACKNOWLEDGMENTS

Administration and support service at Institut Pasteur. Professors and coaches of Institut Pasteur, ESPCI PARIS, ENSCI-Les Ateliers, University Jean Monnet Paris Saclay, University Paris Pierre et Marie Curie, University Paris Diderot, ETSL. Dr Anna-Bella Failloux, Mr. Edouard Guilhot-Gaudeffroy, Dr. Gregory Lambert, Dr. Jean-Claude Manuguerra, Dr. Jessica Vanhomwegen, Mrs. Yvette Tran and Mrs. Hélène Montes. Hervé Waxin, the secretaries and our lab technicians from the Education Center of Institut Pasteur.

LINK TO THE WIKI

SCHOOLS

SPONSORS