Mini sensor based on graphene transistor for wine authenticity tracing by DNA detection

Agnes Purwidyantri[1]
Sarah Azinheiro[1,2], Carla Teixeira[1,3], Andrey Ipatov[1], Telma Domingues[4], Marco Martins[5], Jérôme Borme[4], Pedro Alpuim[4,6], Marta Prado[1]

[1]*Food Quality and Safety Group, International Iberian Nanotechnology Laboratory (INL), Av. Mestre José Veiga, 4715-330 Braga, Portugal*
[2]*Department of Analytical Chemistry, Nutrition and Food Science, College of Pharmacy/School of Veterinary Sciences, University of Santiago de Compostela, Campus Vida, E-15782, Santiago de Compostela, Spain*
[3]*Biological Engineering Department, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal*
[4]*2D Materials and Devices Group, International Iberian Nanotechnology Laboratory (INL), Av. Mestre José Veiga, 4715-330 Braga, Portugal*
[5]*Technology Engineering Group, International Iberian Nanotechnology Laboratory (INL), Av. Mestre José Veiga, 4715-330 Braga, Portugal*
[6]*Center of Physics, University of Minho, 4710-057 Braga, Portugal*
agnes.purwidyantri@inl.int

Wine is one of the world´s premium products susceptible to fraudulency. An analytical sensing method to detect adulteration and mislabelling for wines made of highly valued grape varieties is urgently required to protect the entire sectors in wine industry and viticulture business. Authenticity detection based on DNA analysis is a versatile technique because of the high specificity, molecular stability, and sensitivity of polymerase chain reaction (PCR) due to its amplification power [1]. This study presents a mini DNA sensor integrating graphene field-effect transistors (GFET). Monolayer graphene as the sensing membrane is modified with a pyrene-based linker through the π- π interaction to capture the amine-tagged DNA probe exposed to samples containing the complementary strands [2]. The portable system enables a rapid and straightforward screening of biochemical interactions onto the graphene chip through the Dirac voltage shift measurement. We specifically designed the probe DNA from the F3H gene of the *V. vinifera* (grapevine) to identify grape varieties from Douro (Portugal) Protected Designation of Origin (PDO). The integrated system shows a distinguished sensitivities for the detection of DNA hybridization in the PCR-amplified DNA samples from several grape varieties with different degree of mismatches, including Tinta Barocca and Tinta Francisca. The findings essentially denote the potentials of this miniaturized DNA sensor for the escalated level of detection in a complex sample matrix and the application for on-site detection.

REFERENCE

[1] K. Böhme, P. Calo-Mata, J. Barros-Velázquez, and I. Ortea, “Review of Recent DNA-Based Methods for Main Food-Authentication Topics,” *J. Agric. Food Chem.*, vol. 67, no. 14, pp. 3854–3864, 2019.
[2] A. Purwidyantri *et al.*, “Influence of the Electrolyte Salt Concentration on DNA Detection with Graphene Transistors,” *Biosensors*, vol. 11, no. 1, p. 24, 2021.

FIGURES

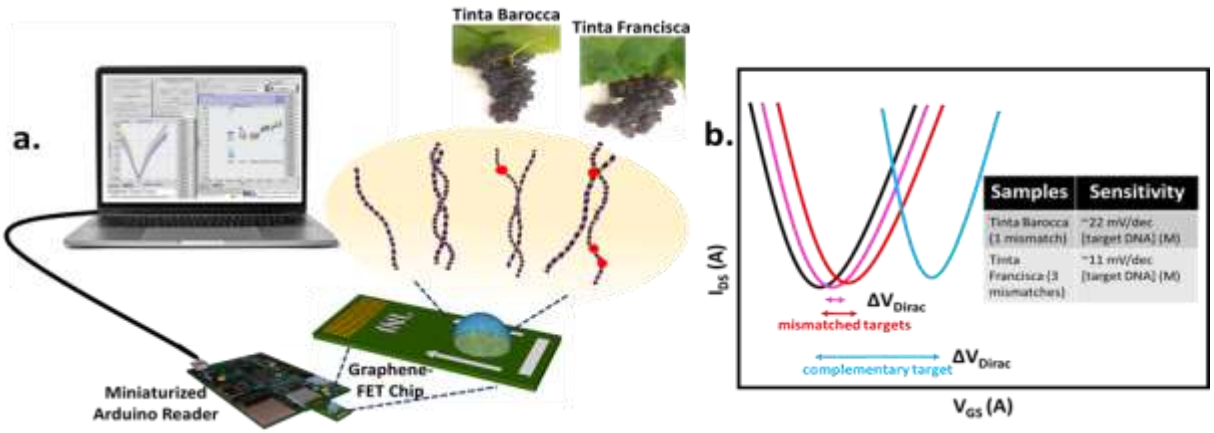

Figure 1: a. The mini sensor based on graphene-FET and b. the characteristics of transfer curves and sensitivity in DNA-based grapevine variety identification.