Surface Chemistry for Direct Pancreatic Cancer Detection Using an Optical Fibre Biosensor

Adam Garon[af], Suresh Venkatachalapathy[e]*, Ricardo Correia[a], Sergiy Korposh[a]*, Steve Morgan[a], Seung-Woo Lee[f], George Gordon[a], Bapan Pramanik[b], Alvaro Mata[b], Guruprasad Aithal[cd], Stuart Astbury[cd]

[a] Optics and Photonics Research Group, Faculty of Engineering, University of Nottingham, NG7 2RD, United Kingdom; [b] School of Pharmacy, University of Nottingham, NG7 2RD, United Kingdom; [c] Nottingham Digestive Diseases Centre, Translational Medical Sciences, School of Medicine, University of Nottingham, NG7 2RD, United Kingdom; [d] NIHR Nottingham Biomedical Research Centre, Nottingham University Hospitals NHS Trust and the University of Nottingham, NG7 2RD, United Kingdom; [e] Nottingham University Hospitals NHS Trust, NG5 1PB, United Kingdom; [f] Department of Chemical and Environmental Engineering, The University of Kitakyushu, 808-0135, Japan
E-mail: suresh.venkatachalapathy@nuh.nhs.uk*, eezsk2@nottingham.ac.uk*

15% of pancreatic cysts have a lining that can develop into pancreatic cancers, and mucinous cysts have malignant potential, generally between 0.24%-0.72% per year[1]. However, for some cyst types, such as intraductal papillary mucinous neoplasms (IPMN), the risk rises to 10% after five years[2] and is substantially higher at 26% for pancreatic cysts ≥ 2 cm.[3] Mucin has shown great promise as a biomarker for pancreatic cancer due to the expression rates of different mucin genes being linked to carcinogenesis in a range of pancreatic cysts[1]. We aim to accurately detect the mucinous content of pancreatic cyst fluid without aspiration by guiding an optical fibre mucin sensor into pancreatic cysts through an endoscopic ultrasound (EUS) needle, allowing identification of the presence and potential concentration of mucin in pancreatic cyst fluid during the procedure, enabling evaluation of cancerous potential. A gold nanoparticle (AuNP, diameter of 50 nm)-functionalised optical fibre-tip surface plasmon resonance (SPR) biosensor was fabricated to identify the presence and concentration of mucin in phosphate buffered saline (PBS) solution. The sensor was fabricated by layer-by-layer chemical deposition using peptides as bioreceptors and tested on 0, 40, 80, and 120 µg/ml mucin I-S solutions.

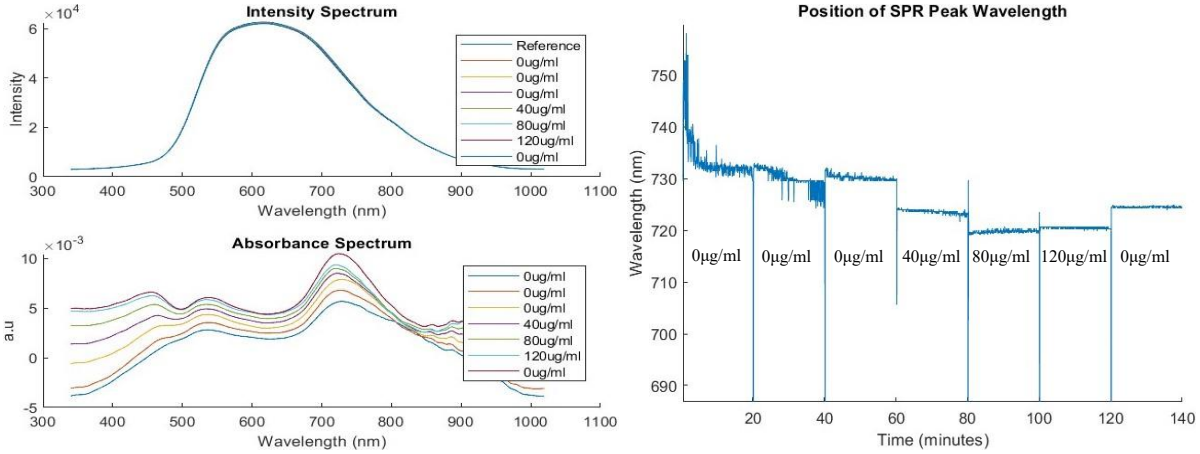

Figure 1. Experimental results showing the intensity and absorption spectra (left) and the position of the SPR peak wavelength (right) of the mucin biosensor in different mucin solutions

References

[1] Scheiman, J. M.; Hwang, J. H.; Moayyedi, P. American Gastroenterological Association Technical Review on the Diagnosis and Management of Asymptomatic Neoplastic Pancreatic Cysts. Gastroenterology 2015, 148 (4), 824-848.e22. https://doi.org/10.1053/J.GASTRO.2015.01.014.

[2] Choi, S. H.; Park, S. H.; Kim, K. W.; Lee, J. Y.; Lee, S. S. Progression of Unresected Intraductal Papillary Mucinous Neoplasms of the Pancreas to Cancer: A Systematic Review and Meta-Analysis. Clin Gastroenterol Hepatol 2017, 15 (10), 1509-1520.e4. https://doi.org/10.1016/J.CGH.2017.03.020.

[3] Kromrey, M. L.; Bülow, R.; Hübner, J.; Paperlein, C.; Lerch, M. M.; Ittermann, T.; Völzke, H.; Mayerle, J.; Kühn, J. P. Prospective Study on the Incidence, Prevalence and 5-Year Pancreatic-Related Mortality of Pancreatic Cysts in a Population-Based Study. Gut 2018, 67 (1), 138–145. https://doi.org/10.1136/GUTJNL-2016-313127.