Biomedical Applications of Synchrotron-based Infrared Microspectroscopy at NSRRC

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The end-station of synchrotron-based infrared microspectroscopy (SR-IMS) at BL14A1 of NSRRC in Taiwan is equipped with an infrared microspectroscopic bench of Fourier-transform infrared (FT-IR) spectrometer coupled with an infrared confocal microscope using infrared synchrotron radiation as light source. The unapertured focused infrared beam size of NSRRC synchrotron radiation at full width at half maximum (FWHM) of NSRRC is about 10 × 13 μm^2 for giving ultrahigh spatial resolution in FT-IR imaging acquisition, being utilized for the detection at diffraction limited sample area. Based on the advantage of ultrahigh spatial resolution of infrared synchrotron radiation, end-station of SR-IMS is able to be employed for acquiring ultrahigh spatially-resolved spectral image of functional group of bio-components within biological sample [1, 2]. In this study, we successfully demonstrated an innovative method of wax physisorption kinetics (WPK) for fast discriminating malignancy from normal for oral cavity cancer using N-alkanes of C22-C34 frame and beeswax ($C_{46}H_{92}O_2$) as diagnostic wax agents, and relative amount of residual wax onto cell surface was measured by using FT-IR imaging shown in the Fig. 1 [3]. Moreover, paraffin ($C_{25}H_{52}$) and beeswax are potential diagnostic wax agents and work excellently for screening colorectal cancer, gastric cancer, cervical cancer, and prostate cancer. The relative amount of residual wax adhering onto cell surface was employed as a signpost for differentiating malignancy from normal according to the variance of wax physisorption of membrane polarizability between normal and cancer cell. We proposed that oligosaccharides of residual glycoprotein within cell membrane play a crucial role of physisorption with wax agent during the treatment of acid-catalyzed hydrolysis and deglycosylation of PNG_{ase} F. Furthermore, bias-assisted wax physisorption kinetics (BA-WPK) was developed for establishing a new standard to define cancer grade of oral cavity cancer using breakdown bias of oligosaccharides of residual glycoprotein within cancer cell surface as applying external bias on cancer cells. Therefore, WPK-based cancer diagnosis could be a potential method for fast cancer screening and grading in the future clinic applications.

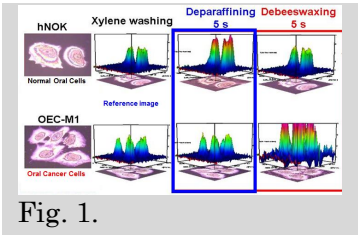

Fig. 1.

Fig. 1. The results of wax physisorption kinetics of normal and cancer human oral cavity cells showed a variant physisorption capability between paraffin and beeswax.

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