Diagnosis of Skin Cancer with Synchrotron IR Microspectroscopy

Synchrotron-based FT-IR Imaging technique can help in diagnosis of arsenic-induced skin cancer.

Abnormal cell proliferation and dysregulated energy homeostasis are common mechanisms for carcinogenesis induced by arsenic exposure (AP). As protein glycosylation is involved in the physiological processes of cell proliferation and differentiation, the AP might play a key role in the induction of aberrant glycosylation and might lead to abnormal cell proliferation. Protein glycosylation is crucial in many physiological processes including protein folding and unfolding, cell adhesion and cellular differentiation. Aberrant protein glycosylation was strongly suggested to be related to incomplete synthesis and neo-synthesis of glycosylated proteins, which altered the arrangement and length of protein-linked glycan residues of glycoprotein.[1-4] Researchers from the NSRRC proposed the use of *n*-pentacosane (n-$C_{25}H_{52}$) and beeswax ($C_{30}H_{61}CO_2C_{15}H_{31}$) to evaluate the alteration of membrane protein-linked glycan residues in tumor tissues from patients with oral cavity cancer and ovarian cancer monitored with synchrotron-based Fourier-transform infrared (SR-FTIR) microscope.[5,6]

In this work, a joint team consisting of members from Kaohsiung Chang Gung Memorial Hospital and the NSRRC studied the connection between

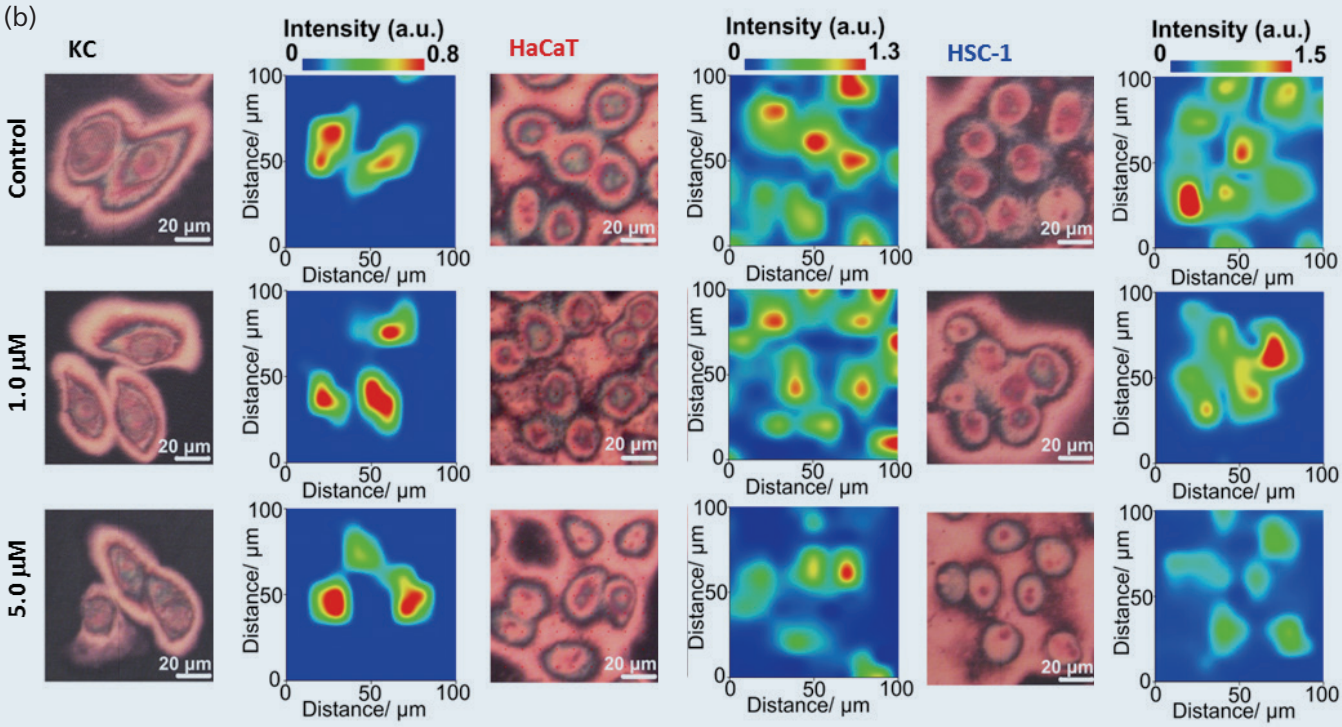

Fig. 1: (a) FTIR spectra of amide A signal in cell samples after arsenite exposure (0 and 5 μM) in range 3500-3000 cm^{-1} acquired using a FTIR spectrometer coupled with an infrared integrating sphere. (b) Images for intensity of the amide A line for cell samples after treatment with sodium arsenite (0, 1 and 5 μM) using a SR-FTIR microscope. [Reproduced from Ref. 7]

the variation of the chain length of glycan residues of membrane glycoproteins on cell surface and cell proliferation of KC, HaCaT and HSC-1 cells during exposure to arsenite, using SR-FTIR imaging at **TLS 14A1**.[7] Three skin cells were treated with an ATP synthase inhibitor, oligomycin, before arsenite exposure, followed by monitoring the behavior of wax physisorption with SR-FIIR imagine, to investigate the association between ATP and the structure alteration of glycan residues.

The intensity of the amide A signal decreased for KC, HaCaT and HSC-1 cells after exposure to arsenite (5 μM) (**Fig. 1(a)**). The SR-FTIR microspectra results for the height images of the amide A signal showed that the protein content of KC and HSC-1 cells was increased after exposure to sodium arsenite (1 μM) but decreased after exposure to sodium arsenite (5 μM) (**Fig. 1(b)**), but the protein content of HaCaT cells decreased with an increased arsenite concentration. These results indicated that the intensity of the amide A signal was a sensitive indicator for skin cells after arsenite exposure, and the three skin cells were obviously stressed by the exposure to arsenite (5 μM) (**Fig. 1**).

This work showed that the alteration of protein-linked glycan residues was associated with cell proliferation and revealed the connection between an elongation of protein-linked glycan residues and ATP in the model of arsenite-treated primary KC, detected using the WPK-FPA-FTIR imaging technique. The alteration of glycan residue structure might hence play a crucial role in the progression of arsenic-induced skin cancers. The WPK-FPA-FTIR imaging technique performed with selected aliphatic lengths of wax adsorbents might serve as an economic tool for diagnosis of abnormal glycosylation-related diseases. (Reported by Yu-Jong Wu and Chia-Yen Hsu)

This report features the collaborative work of Chih-Hung Lee, Yao-Chang Lee, Hsin-Su Yu and their co-workers published in Int. J. Mol. Sci. ***17****, 427 (2016).*

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- Synchrotron-based FTIR (SR-FTIR) Microspectroscopy
- Biochemistry and Molecular Biology

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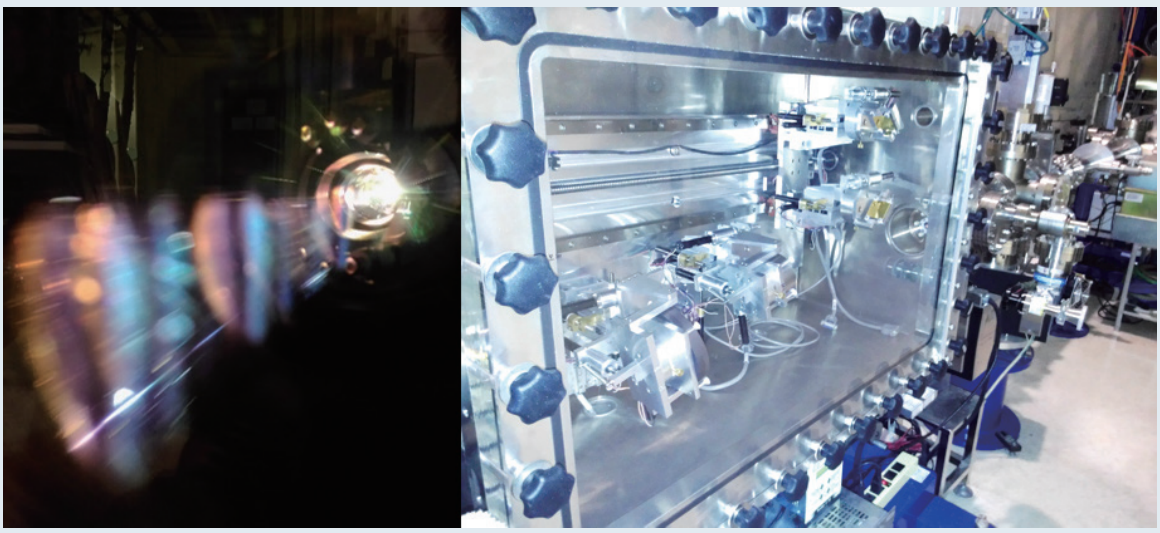

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