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Recent Advances in Macro ATR-FTIR Microspectroscopic Technique for High Resolution Surface Characterisation at Australian Synchrotron IR Beamline

Highly collimated synchrotron-IR beam offers 100-1000 times higher brightness than that of internal IR source used in laboratory-based FTIR instruments, enabling acquisition of high-quality FTIR spectra at diffraction-limited spatial resolution. Such properties make synchrotron-IR an excellent analytical platform for acquiring spatially resolved chemical "mapping" of materials at lateral resolution between 3-10µm.

Attenuated total reflection (ATR) FTIR technique is widely used for probing surface-specific molecular information of materials. Coupling synchrotron-IR beam to an ATR element further enhances the lateral resolution greater than those in transmission/reflectance, by a factor of refractive index (n) of the ATR element. For mapping measurements using Ge element (n=4), this has the effect of not only reducing the beam focus size (improving the lateral resolution) by a factor of 4, but also reducing the mapping step size by 4 times relative to the stage step motion. As a result, ATR-FTIR measurement at Australian Synchrotron IR Beamline can be performed at minimum beam size of 1.9µm/1.2µm (with 20x/32x objective), and at minimum mapping step size of 250 nm.

Unlike microscopic-ATR (micro-ATR) technique, macro-ATR approach requires only a single contact between the ATR element and the sample throughout the measurement minimising potential of sample damage and also providing a faster scanning speed.

This work presents recent advances in macro-ATR devices developed at Australian Synchrotron. Two macro ATR devices have been made available for the users since February 2016. The first model, "hybrid macro-ATR", was developed by modifying the cantilever arm of the standard macro-ATR unit to accept Ge ATR elements with different facet sizes (1mm, 250µm and 100µm in diameter) normally used with micro-ATR objective. While the larger tip works well with softer materials that do not require high pressure, the small tips can provide higher pressure and allow measurements inside smaller regions with limited access suitable for hard/rough surfaces. The other macro-ATR device, "soft-contact piezo-controlled macro-ATR", was designed specifically for analysis of delicate and soft materials, by using a unique combination of piezo-controlled linear translation stages to achieve precise positioning and gentle approach of the sample towards the ATR facet. The capabilities of the technique have been demonstrated through a diverse range of research from material and food science to biology and single fibres.

Keywords or phrases (comma separated)

Synchrotron-IR, Macro-ATR, surface characterisation, high resolution

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No

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No

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No

What is your gender?

Female

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