Non-destructive Analysis by Raman Spectroscopy

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Non-destructive analyses mean:

No mechanical, no chemical, no photochemical or thermal decomposition during the preparation or the analysis itself is allowed!

'Classical' Raman spectroscopy cannot fulfil these conditions: Excitation by focused laser radiation in the visible range will destroy any sample absorbing this radiation. Even a very small concentration of fluorescing compounds will overlay the Raman spectrum due to its – by several orders of magnitude – larger quantum yield. Animal or plant tissues contain a machinery of enzymes and coenzymes which absorb in the visible and may be destroyed by photochemical reactions. Even in its low concentration they show heavy fluorescence.

Excitation by radiation in the near infrared range – at 1064 nm, produced by a Nd:YAG-Laser will not be absorbed by most samples and does not excite fluorescence. However, the intensity of the Raman radiation is very low, due to the ν^4 factor, which reduces the intensity when going to longer wavelengths (lower frequencies). Several modifications of 'classical' Raman spectroscopy allow nevertheless analyses at small recording times: Multiple reflection sample arrangements enhance the intensity of the excitation and also the collection of the Raman radiation. Using interferometers, due to its 'Jacquinot advantage' [1] enhances the recorded intensity by about 2 orders of magnitude compared to 'classical' dispersive spectrometers.

Examples of application of the non-destructive technique are shown: analyses of historic textiles, precious art work, animal or plant tissues [2-3]. Of special interest is the analysis of plants allowing the identification and the distribution of natural compounds, e.g. polyacetylenes [4]. Due to the very small photophysical activity the induction of polymorphic phase transitions is reduced [3].

References

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