# TRACING THE UPTAKE OF METHANOL BY PMMA USING FEMTOSECOND STIMULATED RAMAN MICROSCOPY (FSRM)

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The uptake of solvent molecules into a polymer matrix can affect many different products and processes, for example, packaging, drug delivery, membrane processes and sensors [1]. For a profound understanding of this process concentration profiles of the penetrating solvent and their temporal evolution are highly desirable. Even for a classical, well studied polymer-solvent pair such as poly(methyl methacrylate) (PMMA) and methanol such profiles have not been recorded yet. One technique which is capable of recording such concentration profiles is Raman imaging. However, since the signals in conventional Raman imaging are very low it would require quite a long time to record a full profile. Here, a non-linear Raman technique, namely femtosecond stimulated Raman microscopy (FSRM), is employed to speed up the acquisition.

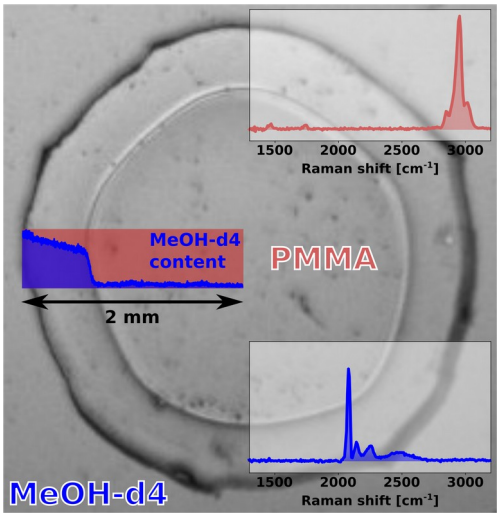


Figure 1: Transmission micrograph of the sample during the methanol uptake with the concentration profile as well as the Raman spectra of the two neat materials.

FSRM was introduced by our group in 2007 [2] as a novel broadband technique for Raman imaging. A spectrally broad femtosecond laser pulse and a narrow but intense picosecond laser pulse are used to record the complete stimulated Raman spectrum at one focal spot of the sample within 0.1 ms [3]. Until now this technique has only been applied to static problems in polymer science. In this work we show that, due to its speed, it is possible to utilize FSRM for the tracking of dynamic processes such as the uptake of methanol by PMMA.
Since FSRM delivers the complete Raman spectrum of the sample it contains information about PMMA as well as methanol. Analysis of the respective Raman images yields the methanol content inside the PMMA sample as a function of position and time. An exemplary concentration profile of methanol is shown in the inset in Figure 1. The methanol content in the sample exhibits a sudden drop when moving from the boundary of the sample towards its center. This drop coincides with a moving front which is visible in simple transmission images.

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