

DIFFUSION OF METHANOL INTO PMMA STUDIED BY FEMTOSECOND STIMULATED RAMAN MICROSCOPY (FSRM)

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Polymers are of major industrial as well as scientific importance. Their applications range from packaging materials to medical applications in drug delivery systems. For many applications the diffusion of small molecules through the polymer is a very important property [1].

A prototypical process in this field is the diffusion of methanol (MeOH) into poly(methyl methacrylate) (PMMA). In a classical study Thomas and Windle used light microscopy to track iodine-stained MeOH in PMMA plates [2]. The problem with this method is that it tracks the iodine and not the MeOH. Other label-free methods suffer from low resolutions (NMR) or do not yield a concentration profile (gravimetric methods) [1].

With its chemical selectivity Raman microscopy is an ideal method to get the concentration profile of MeOH. But due to low Raman cross-sections and the resulting long acquisition times comprehensive studies of the whole diffusion process are difficult.

In 2007, our group first introduced a broadband Raman technique referred to as femtosecond stimulated Raman microscopy (FSRM) [3]. It was recently demonstrated that with this technique, acquisition times per Raman spectrum as short as 0.1 ms are possible [4]. With this speed FSRM is a suitable tool to record the complete concentration profile of MeOH in PMMA without using a label in just a few minutes.

In this work, we present the first results of tracking the diffusion of MeOH into PMMA by FSRM. PMMA disks with a radius of 2 mm and a thickness of about 200 μm were sandwiched between two glass plates and surrounded by MeOH (see Fig. 1). Concentration profiles were extracted every hour by multivariate analysis of the Raman data.

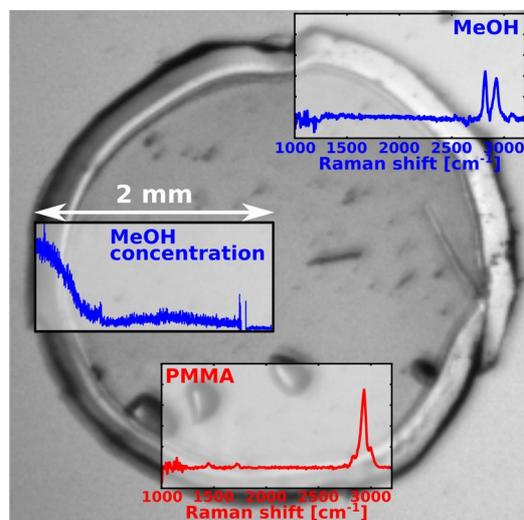


Figure 1: Photograph of the sample and Raman spectra employed to obtain the concentration profiles.

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