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In situ photoacoustic spectroscopic studies on heterogeneous catalysts under conditions of gas flow*

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Abstract. An all-glass open photoacoustic cell through which gases can be passed without affecting the signal has been described. The cell has been characterized for various chopping frequencies and temperatures. Several heterogeneous catalytic reactions have been studied under conditions of gas flow at elevated temperatures and the potential application of this method in the field of heterogeneous catalysis has been pointed out.

Keywords. Photoacoustic spectroscopy; open photoacoustic cell; heterogeneous catalyst; catalytic reactions.

1. Introduction

In the last decade or so there has been a revived interest in the study of photoacoustic (PA) effect from condensed matter (Ganguly and Rao 1981; Tam 1986), after the pioneering work of Bell (1881) on the 'sonorousness' of the materials under the influence of intermittent light. This revival of interest was mainly due to the belief that the PA effect could be gainfully employed to obtain optical spectra of materials like gels and translucent solids which are normally inaccessible to the conventional spectroscopic techniques. Secondly it was believed that even thermal properties could be studied because of the dependence of the PA signal on thermal parameters. There have been several occasions where the belief has come true. Hence, there has been enormous growth since the revival in various branches of PA effect. Optical spectra have been recorded on powdered and light scattering materials (Monahan and Nolle 1977); thermal properties have been studied by Adams and Kirkbright (1977); phase transitions studied (Somasundaram *et al* 1986). Besides these applications there have been photoacoustic microscopic studies (Wickramasinghe *et al* 1978; Wong *et al* 1978), biological studies (Balasubramanian and Mohan Rao 1981) and surface studies (Low and Parodi 1980; Somasundaram *et al* 1987). The main advantage of using PAS for spectroscopic studies is the fact that the sample preparation is not very critical and in principle spectra can be recorded even from opaque solids. The disadvantages are the saturation effect and the difficulty in getting a quantitative measure of absorption coefficient β. Taking all these into account it was believed that the area of photoacoustic spectroscopy would be especially useful in the study of surfaces and more specifically those of catalysts which have high surface area. The high surface area of catalysts essentially increases the signal intensities (due to the possible increase in efficient heat transfer) and reduces the saturation effects.

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