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Gravimetric and profilometric measurements of the ablation rates of photosensitive polymers at different wavelengths

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Abstract

The ablation rates of two polyimides (PMDA and Durimid™) and one triazene polymer were studied by gravimetric (quartz microbalance) and profilometric (profilometer) methods at irradiation wavelengths of 193, 248 and 308 nm. The ablation rates determined by the two methods are discussed in the context of the absorption behavior of the materials. Furthermore, the consistence of the two experimental methods is discussed for the ablation rates of Durimid™ and the triazene polymer. The gravimetric measurements revealed a good correlation between the ablation rate and the absorption properties of the examined materials. The comparison of the gravimetric and the profilometric measurements suggest a significant mass removal, e.g. by formation of gaseous products, prior to the detection of changes in the surface morphology.

Keywords: Polyimides; Quartz microbalance; Profilometer

1. Introduction

UV laser ablation of polymers is the objective of intense experimental and theoretical research due to the potential applications in many fields (chemistry, physics, biology, and electronics) [1–3]. Studies of the laser-induced decomposition or transformation of polymers with single pulses and laser fluences close to the threshold of ablation require very sensitive techniques, such as a quartz crystal microbalance (QMB), atomic force microscopy (AFM) or profilometry. One important question in polymer ablation is related to the ablation mechanism, i.e., photochemical versus photothermal. The understanding of these mechanisms is important for the design of new materials (e.g. photosensitive polymers) or the optimization of existing industrial processes. Models also play an important role in the understanding of these mechanisms. The mass loss during laser irradiation is one important parameter for the development of theoretical models that describe ablation.

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