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UV LED absorption spectroscopy for pulsed plasma diagnostics

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Broad band UV absorption spectroscopy (UVAS) is a well known technique to measure the density of small polyatomic radicals in reactive plasmas. Recently, it has been shown that by replacing the typical Xe (or D2) light sources by UV Light emitting Diodes (LED) it was possible to increase the sensitivity of this technique by an order of magnitude. We show that owing to this sensitivity gain, UVAS can be used to probe the radical's loss/production kinetics by monitoring their density in the afterglow of pulsed discharges with a time resolution of 10 μs. In the past, such measurements were feasible only by Laser Induced Fluorescence with a much more sophisticated and expensive equipment. This technique is applied to investigate the Chlorine pulsed plasma used for silicon etching. The recombination coefficient of Cl atoms on the reactor walls is first deduced from the rise rate of the Cl2 density in the afterglow. Then we show that the kinetics of SiCl and SiCl2 etch products in the afterglow is complex. SiCl is lost at high rate both by sticking on the reactor walls and by reacting with Cl2 molecules with a rate approaching the collision frequency. SiCl2 is produced from this reaction, but it is also lost by either sticking on the walls or a slow chemical reaction in the gas phase, both with small probabilities.

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