

Measurements of CF_x and SiH_x Radicals in ECR and RF Plasmas used for Material Processing

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Abstract

In material processing using plasmas, although radicals such as SiH₃, SiH₂, and CF₃ are very important as precursors of thin film in CVD and protection film on the side wall in etching, their measurements in plasmas have never been made for the lack of measurement methods.

We developed new laser spectroscopic techniques such as infrared diode laser absorption spectroscopy and modified laser induced fluorescence spectroscopy, and succeeded in making in-situ measurements of densities of CF_x and SiH_x radicals in plasmas used for etching and deposition for the first time.

The following table shows radicals which we measured in ECR and RF plasmas for material processing. In this review talk, main results on behaviors of those radicals in plasmas will be introduced.

Molecule	Radical	Band (μm)	Plasma	Method
SiH ₄	SiH ₃	ν_2 (15)	RF, ECR	IRLAS
	SiH ₂	A-X (0.6)	RF	MLIF
	SiH	$\nu=0-1$ (5)	RF, ECR	IRLAS
	Si	4s-3p ² (0.29)	RF, ECR	RLAS
CF ₄	CF ₂	ν_3 (9)	RF	IRLAS
	CF	$\nu=0-1$ (8)	RF	IRLAS
CHF ₃	CF ₃	ν_3 (8)	RF, ECR	IRLAS
	CF ₂	ν_1 (9)	RF, ECR	IRLAS
	CF	$\nu=0-1$ (8)	RF, ECR	IRLAS
C ₄ F ₈	CF ₃	ν_3 (8)	ECR	IRLAS
	CF ₂	ν_1 (9)	ECR	IRLAS
	CF	$\nu=0-1$ (8)	ECR	IRLAS

IRLAS : Infrared diode laser absorption spectroscopy

MLIF : Modified laser induced fluorescence spectroscopy

RLAS : Ring dye laser absorption spectroscopy